Longline Fisheries of the United States: Seabird Bycatch Assessments, Descriptions, Regulations, Current Mitigation Efforts, Current Research Efforts, and Monitoring of Seabird Bycatch by Fishery Management Council Fisheries and International Agreements

A longline is "a line that is deployed horizontally and to which gangions and hooks or pots are attached. Longlines can be stationary,anchored, or bouyed lines that may be hauled manually, electrically, or hydraulically" (U.S.C. § 600.10). There are many other regional terms for similar types of gear, including hook-and-line gear and tub trawling. Although IPOA-S did not define the term "longline," the international fishing community has a common understanding of the equipment and techniques used with this style of fishing. This type of gear is generally deployed from the sterns of fishing vessels, with the main line following the vessel in a diagonal line until it enters the water.

There are many different types of longline fisheries in U.S. waters or in which U.S. fishermen participate, each modified for the individual nature of a particular fishery. The following sections contain descriptions of all the United States fisheries in which longline gear is allowed (NMFS 1999). However, not all of these fisheries include participants that are or have been using this gear, and if not applicable, it is noted that there are no active longlines currently used.

Domestic Fisheries by Fishery Management Council (FMC)

New England Fishery Management Council

Introduction

The groundfish fleet of New England is one of the most recognizable in the world, and is the oldest commercial fishery in the United States. The New England Fishery Management Council (NE Council) has management responsibility for developing fishery management plans for groundfish in New England waters, including Georges Bank and the Gulf of Maine. This species complex, managed under the Northeast Multispecies (Groundfish) Fishery Management Plan (Groundfish FMP), currently includes Atlantic cod (*Gadus morhua*), witch flounder (*Glyptocephalus cynoglossus*), American plaice (*Hippoglossoides platessoides*), yellowtail flounder (*Limanda ferruginea*), ocean pout (*Macrozoarces americanus*), haddock (*Melanogrammus aeglefinus*), silver hake (*Merluccius bilinearis*), pollock (*Pollachius virens*), winter flounder (*Pseudopleuronectes americanus*), windowpane flounder (*Scophthalmus aquosus*), redfish (*Sebastes faciatus*), red hake (*Urophycis chuss*), white hake (*Urophycis tenuis*), Atlantic halibut (*Hippoglossus hippoglossus*), and offshore hake (*Merluccius albidus*). These species are harvested mainly by trawlers and hook-and-line longliners. The NE Council developed this FMP under the Magnuson-Stevens Act. The initial Groundfish FMP was approved by the Secretary of Commerce and became effective in 1986 and has undergone 24 frameworks adjustments and nine amendments. This ninth amendment added Atlantic halibut to the list of species managed under the Groundfish FMP.

Other less-utilized species began to be harvested and landed as the major groundfish fisheries declined. Concerned with the decreasing size of landed monkfish (*Lophius americanus*), fishermen and dealers requested the development of management measures to protect the species. The monkfish fishery is now managed jointly by the NE Council and the Mid-Atlantic Fishery Management Council under the Monkfish FMP of 1998.

Seabird Bycatch Assessment

No formal seabird assessments have been conducted. There are relatively few interactions between seabirds and demersal longline fisheries in this region, yet occasional interactions do occur. Fishermen report that most of these rare interactions involve shearwaters and "large gulls" (Openshaw pers. comm. 1999; Beideman pers. comm. 1999).

The Northeast has had limited observer coverage on its groundfish longline fleet. Responsibilities for maintaining the observer data shifted to the Southeast Region in 1996. Because of the historical emphasis on trawl and pot gear in most of the region's fisheries, much of the seabird bycatch research has not been on longline gear. One comparison of observed interaction rates between seabirds and commercial fishing gear in New England from 1991 through 1993 found sink gillnets to also have many seabird interactions (Lanza and Griffin 1997).

Amendment 5 (1993) assessed the seabird risk in this fishery as follows:

> **Seabirds**
> In addition to marine mammals and sea turtles, seabirds are vulnerable to entanglement in commercial fishing gear (Proposed Regime to Govern Interactions Between Marine Mammals and Commercial Fishing Operations, 1991). The interaction has not been quantified in the Northeast multispecies groundfish fishery, but impacts are not considered significant. Endangered and threatened bird species, which include the roseate tern and piping plover, are not impacted by the groundfish gear (Paul Nickerson, U.S. Fish and Wildlife, pers. comm.)

Description of Fisheries

The <u>Northeast Groundfish</u> complex includes many of the traditional groundfish species. Of the fourteen species included in the management plan, only a few are targeted by demersal longline gear, notably Atlantic cod. The decline of many of these fisheries had decreased the total number of longline sets for groundfish species, although the rebuilding of these fisheries, and the subsequent development of alternative ones, may bring about a renewed interest in longlining as the gear of choice. There are few groundfish longline vessels from this region, with trawling and pot fishing being the dominant non-HMS gear types.

The Groundfish FMP has a number of regulations in place due to the depleted status of most groundfish stocks in the region. These regulations range from a restrictive limited entry program to area closures to prohibitions on gear types, and all serve to reduce the number of opportunities for seabird interactions. There is no specific regulation regarding the reduction of seabird bycatch or the mandatory use of mitigation techniques. There is relatively little known about the effects of groundfish longline gear on regional seabird populations.

The <u>Atlantic Halibut</u> fishery was historically important to the New England fisheries, particularly in the nineteenth century, but the resource has been depleted for such a long time that most landings of this species are incidental catches from other directed fisheries. Current participation in the halibut fishery is approximately 50 vessels, almost all of which occur in state waters of Maine during April and May. The gear per vessel consists of "one to ten tub trawls [demersal longlines] consisting of 40-100 hooks each [which are then set] over the gravel and clay bottom." (NEFMC 1998)

Although mostly in state waters, some vessels may have also fished in the EEZ. Amendment 7 to the Groundfish FMP, however, prohibited "fishing in the EEZ (and federally permitted vessels fishing in state waters) with gear capable of catching groundfish, such as longlines, unless fishing under DAS [the "days-at-sea" management regime] or in an approved exempted or experimental fishery." (NEFMC 1998) There are no such fisheries for halibut now in effect, and hence seabird bycatch in this historical longline fishery should not exist at this time.

<u>Monkfish</u> for many years was considered an underutilized species in this region, and only recently has been targeted directly using trawls, gill nets and the occasional longline gear. Today, most of the landings are still bycatch rather than from the directed fishery. Many sea scallop vessels in particular land a substantial number of monktails and livers.

Current Seabird Mitigation Efforts

There are no regulatory measures in place in these fisheries specifically addressing seabird mortality, although there are provisions such as the three large area closures (Closed Area I, Closed Area II, and the Nantucket Lightship Closed Area) and the rolling Gulf of Maine closed areas. These closed areas may provide an additional element of protection by eliminating the possibility of an interaction.

Mid-Atlantic Fishery Management Council

Introduction

The Mid-Atlantic Fishery Management Council (MA Council) includes members from New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, and North Carolina (North Carolina also has a seat on the South Atlantic FMC). This council has primary responsibility for the development of the following FMPs: a) Summer Flounder, Scup, Black Sea Bass; b) Atlantic Bluefish; c) Atlantic Mackerel, Squid and Butterfish; and d) Tilefish. The MA Council also jointly manages the monkfish and spiny dogfish fisheries with the NE Council.

Seabird Bycatch Assessment

No specific seabird assessments have been conducted for these fisheries, because observer data indicate that there are very few interactions between longline gear and seabirds in the MA Council's area of jurisdiction.

Description of Fisheries

Summer Flounder, Scup, Black Sea Bass; Atlantic Bluefish; Atlantic Mackerel, Squid and Butterfish
The species (*Pleuronectes americanus*, *Stenotomus chrysops*, *Centropristis striatus*; *Pomatomus saltatrix*; *Scomberomorus sp.*, *Loligo* and *Illex spp.*, *Peprilus tricanthus*) covered under these management plans are not actively pursued commercially with longline gear, therefore seabird interactions with longlines do not happen. Longline fishing gear is technically approved, however, for all these species (64 FR 67511-67524). In particular, the Atlantic mackerel, squid and butterfish fisheries do not use longlines either recreationally or commercially, and so there are no interactions in these fisheries between seabirds and longlines (Seagraves 1999).

Tilefish (*Lopholatilus camaeleonticeps*) have historically been retained in varying amounts as incidental catch in other fisheries and by recreational anglers. Vessels targeting tilefish generally use longline gear (MAFMC 1999). Although a draft Tilefish FMP was adopted by the MA Council and NMFS in May 1999, the final Tilefish FMP has not yet been adopted or approved.

No research has been conducted on the seabird bycatch of this fishery, making any estimates on this bycatch strictly anecdotal. It has been reported, however, that because of the limited number of participants in this fishery and the nature of the gear, the seabird bycatch is very close to zero (Hoff pers. comm. 1999). Some measures found within this FMP, however, reduce this potential bycatch even further. In addition to the required licensing and permitting regulations, this draft FMP implements a quarterly-set commercial quota, limited entry to the fishery, and closure of the fishery for one month. In addition, the imposition of a 10-year rebuilding schedule for the species will require decreasing landings, reducing even further the longline fishing effort.

Current Seabird Mitigation Efforts

There are no management measures currently in place for seabird bycatch mitigation.

South Atlantic Fishery Management Council

Introduction

The South Atlantic Fishery Management Council (SA Council) develops FMPs for the fisheries from three to 200 miles off the coasts of North Carolina, South Carolina, Georgia, and the East Coast of Florida. The SA Council has also developed a joint FMP for the bluefish stock with the MA Council. Only the Snapper-Grouper fishery in the SA Council management area regularly uses longlines.

Seabird Bycatch Assessment

There have not been specific seabird bycatch assessments in this fishery, although interactions between the fishery and seabirds are believed to be rare.

Description of Fisheries

The "Snapper-Grouper Complex" for management purposes consists of "demersal tropical and subtropical species which generally occupy the same type of habitat and are caught by common fishing methods on the Continental Shelf off the southeastern United States. In this fishery, there are eight families consisting of 69 species" (SAFMC 1983).

Fishing for groupers and snappers began commercially in the South Atlantic bight in the late 19th century, although landings until the 1950s remained in the range of a few thousand pounds (SAFMC 1983). Technological improvements and changes in gear types increased annual commercial harvests of snappers and groupers to almost 400,000 pounds in 1990, but these landings have since decreased to 23,528 pounds in 1998 (NMFS 1999). Demersal longlining is one of four main gear types used in this fishery, with recent landing statistics indicating that longlines are rarely used in the current fishery. The gear consists of circle hooks on 12-18 inch gangions, which are then connected by clips to a longline one to five miles long. Many vessels use a hydraulic pump to power the longline reel.

The Southeast Fishery Science Center (SEFSC) has been responsible for all pelagic observer programs in the Atlantic since 1996. From 1992 to 1995, the SEFSC concentrated observer efforts below the 35° N. latitude, although occasionally gathering data from above that line. Longline fishing in this region results in occasional turtle interactions, resulting in more observer coverage than might otherwise exist.

	Snapper-Grouper Complex[1]
Longline Target Species	(not available)
Season	(not available)
Gear Types	Trap, hook-and-line, trawls, longline
Bait Used (longline)	(not available)
Average Sets per Day (longline)	One
Number of Hooks per Set	500-600
Area Fished	(not available)
Percent Observer Coverage	(not available)
Number of Longline Vessels in Fishery	30-45
Mean Longline Vessel Length (LOA)	(not available)

[1] Data from SAFMC 1983

Table 1. South Atlantic Fishery Management Council Longline Fishery Summary.

Current Seabird Mitigation Efforts

Regulatory actions in this fishery have not been implemented specifically for seabird protection. However, some regulations, such as Amendment 9 from 1994, will significantly reduce the range and most likely the total number of longline sets within the South Atlantic management region.

<u>Caribbean Fishery Management Council</u>

Introduction

The Caribbean Fishery Management Council's (Caribbean Council) area of jurisdiction encompasses the combined EEZs of the Commonwealth of Puerto Rico and the Territory of the U.S. Virgin Islands, the only Council that does not include any U.S. state. This council is also unique in its management of stocks that are shared among many nations within the Caribbean Sea. The "Reeffish Fishery of the Commonwealth of Puerto Rico and the Territory of the U.S. Virgin Islands" (Reeffish FMP) includes over 350 different species, although the Reeffish FMP only specifically addresses the "64 most commonly landed species" (CFMC 1990). This fishery also includes a high percentage of artesinal fisheries, with much of the total catch consumed within the region.

Seabird Bycatch Assessment

Although the FMP and subsequent revisions have addressed marine mammal and turtle interactions, there has been no formal assessment conducted of seabird bycatch within this management area.

Description of Fisheries

The only longline fishery component of this region under the purview of the Caribbean Fishery Management Council is the deep-water reef fishery. This is a recently developed longline fishery, however, with the original FMP not even listing longline gear in its description of the reef fisheries (CFMC 1985). These deep-water species were generally harvested with fish traps/pots and electric reels, although demersal longlines were employed to "a limited extent" (CFMC 1993). Amendment 2 of this FMP further noted that the total catches of these deep-water snapper species in Puerto Rico declined from 340 metric tons (mt) in 1979 down to 80 mt in 1990.

Current regulations will likely have little effect on the longline take of seabirds due primarily to the low usage of longline gear in this fishery. Specific time-area closures may have an additional effect to reduce interactions simply by eliminating other fishing areas that may otherwise have been targeted by the longline reef fish fishery. Note, however, that legally registered vessels do not have to have a specific permit to fish in this fishery (50 CFR 669.4, 28 August 1985).

Current Seabird Mitigation Efforts

There have not been specific seabird bycatch assessments in this fishery, although interactions between the fishery and seabirds are believed to be very rare.

Gulf of Mexico Fishery Management Council

Introduction

The Gulf of Mexico Fishery Management Council (GM Council) manages species within the U.S. EEZ of the Gulf of Mexico. The fisheries that occasionally use demersal longlines are collectively managed under the Reef Fish Fishery Management Plan. This FMP encompasses many species, and has been amended 16 times since its initial implementation in 1984.

Seabird Bycatch Assessment

Although the FMP and subsequent revisions have addressed marine mammal and turtle interactions, there has been no formal assessment conducted of seabird bycatch within this management area.

Description of Fisheries

There are 42 species identified in the fishery management unit, with approximately an additional 15 included in the fishery (GMFMC 1989). The historical reef fish fisheries occur in water shallower than 100 fathoms, yet due to geomorphic characteristics in the Gulf of Mexico, only an estimated 5.7 percent of the U.S. EEZ is considered reef fish habitat (GMFMC 1989). There are current proposals to remove some of these species from the FMP.

The development of the reef fish fisheries was the first demersal target fishery in the Gulf of Mexico, and standard hook-and-line gear was the prevalent gear type from the 1840s until the broad introduction of fish traps and longlines in the late 1970s. The commercial fishery is comprised of vessels using handlines or “bandit rigs”, traps and pots, and longlines. The longline fleet in the Gulf currently targets three general regions: the western Gulf off the Texas coast, the eastern Gulf off the west-central Florida coast, and the northeast Gulf off the Florida panhandle (GMFMC 1989). Longline gear is similar to that used in other reef fisheries, with the longline measuring between one and six miles long with gangions placed about 10-20 feet apart.

	Reef Fish
Longline Target Species	Red snapper, yellowedge grouper, golden tilefish
Season	(not available)
Gear Types	Handline, trap, pot, demersal longline[2]
Bait Used (longline)	Seasonal: mullet, eels, skate, pollock, spanish mackerel, spanish sardines, cigar minnows, squid[2]
Average Sets per Day (longline)	Up to five[2]
Number of Hooks per Set	120-500 per mile[2]
Area Fished	the western Gulf off the Texas coast, the eastern Gulf off the west-central Florida coast, and the northeast Gulf off the Florida panhandle
Percent Observer Coverage	(not available)
Number of Longline Vessels in Fishery	(not available)
Mean Longline Vessel Length (LOA)	(not available)

[2] From Prytherch (1983) in the GMFMC Reef Fish FMP Amendment 1 (1989)

Table 2. Gulf of Mexico Fishery Management Council Longline Fisheries Summary.

Current Seabird Mitigation Efforts

There have been many regulations that have resulted in the reduction of total longline fishing effort, including closed seasons, reductions in TACs, and even closed areas. In part because longline interactions with seabirds are believed to be rare, none of the regulatory actions for this fishery have directly addressed seabird mitigation techniques or gear modification.

Pacific Fishery Management Council

Introduction

The Pacific Fishery Management Council (Pacific Council) also has a unique management process that includes American Indian tribes as well as state and federal representatives. It has management responsibility for groundfish and coastal pelagic species within the U.S. EEZ off the states of Washington, Oregon, and California. It has the additional responsibility for making management recommendations to the International Pacific Halibut Commission (IPHC).

There are two species complexes that use longlines, the groundfish and highly migratory species (HMS) fisheries. The groundfish fishery includes rockfish (55 species), flatfish (12 species), sharks and skates, roundfish, and others. Note that "roundfish" species include economically important species such as Pacific whiting or hake, sablefish, and lingcod. The Groundfish FMP was developed in 1978 by the Pacific Council and approved by the Secretary of Commerce in 1982. This FMP has been amended nine times, with the most recent Amendment 10 in 1997. The HMS fisheries within the Pacific Council management area include tunas, swordfish, marlins, sailfish, oceanic sharks, and others. These species are harvested by both commercial and recreational fisheries and by foreign fishing fleets, but only a fraction of the total harvest is taken within U.S. waters. There is currently no FMP for these species within the Pacific Council management area. The Pacific Council, however, is currently holding discussions with the Western Pacific and North Pacific Fishery Management Councils to develop a combined management regime for these species.

Seabird Bycatch Assessment

There have not been specific seabird bycatch assessments in these fisheries.

Description of Fisheries

Highly Migratory Species (HMS)
There is currently no fishery management plan for HMS within the Pacific Council authority. A scoping document was publicly circulated in September 1999 to gather comment on the various provisions of a proposed FMP, including bycatch concerns.

West Coast Groundfish
The groundfish fishery is predominantly prosecuted with trawl gear, although there is a limited number of longline vessels actively engaged in the fishery. Although there are no regulations directly relating to seabird bycatch or mitigation requirements, there is currently a combination of limited entry, gear restrictions, vessel landing limits, and time/area closures in place to control effort in the fishery, thereby also limiting opportunities for seabird interactions.

Current Seabird Mitigation Efforts

None of the regulatory actions for these fisheries have directly addressed seabird mitigation techniques or gear modification.

North Pacific Fishery Management Council

Introduction

With jurisdiction over the 900,000 square mile EEZ off Alaska, the North Pacific Fishery Management Council (NP Council) has responsibility for developing FMPs for groundfish management in the Bering Sea and Aleutian Islands (BSAI) and the Gulf of Alaska (GOA), including cod, pollock, flatfish, mackerel, sablefish, and rockfish species harvested mainly by trawlers, hook and line longliners, and pot fishermen. The groundfish fisheries are managed under the Fishery Management Plan for Groundfish of the Gulf of Alaska and the Fishery Management Plan for the Groundfish Fisheries of the Bering Sea and Aleutian Islands Area. Both fishery management plans (FMP) were developed by the NP Council under the Magnuson-Stevens Act. The GOA FMP was approved by the Secretary of Commerce and became effective in 1978 and the BSAI FMP became effective in 1982. Both FMPs were recently updated: the GOA FMP on July 6, 1999 and the BSAI FMP on June 30, 1999.

The Northern Pacific Halibut Act of 1982 (NPHA), P.L. 97-176, 16 U.S.C. 773c(c) requires NMFS to develop regulations governing the Pacific halibut catch in U.S. waters which are in addition to, but not in conflict with, regulations of the International Pacific Halibut Commission (IPHC). The NP Council also makes allocative and limited entry recommendations for halibut, though the IPHC is ultimately responsible for conservation of halibut.

Seabird Bycatch Assessment

Based on the following information, the NMFS Alaska Region has determined that seabird bycatch is a problem in the hook-and-line groundfish and Pacific halibut fisheries off Alaska. Therefore, according to the FAO *International Plan of Action for Reducing Incidental Catch of Seabirds in Longline Fisheries*, the NMFS Alaska Region – in collaboration with the North Pacific Council and the FWS – implemented and will continue to implement as necessary the action items described in the U.S. NPOA-S**.**

Description of Fisheries

The current hook-and-line fisheries can best be characterized according to the area fished and/or the vessel type (Table 1). Relatively large catcher-processor vessels are more common in the BSAI whereas smaller catcher vessels, of diverse size classes, account for most of the harvest activity in the GOA. Obvious similarities occur between these different groups, but differences in gear type, bait used, hooks set per day, setting speed, and other vessel and gear characteristics do occur.

<u>BSAI</u>

<u>Pacific cod</u> has dominated the landings of the hook-and-line fishery. Pacific cod was taken by Japanese hook-and-line and trawl operation beginning in the early 1960s and joined by vessels from the Soviet Union in 1971. The average harvest from 1971-1976 was 50,000 metric tons (mt). Foreign fisheries were phased out by the domestic fleet by 1988. Catches have fluctuated around 165,000 mt since 1985. The Pacific cod total allowable catch (TAC) is apportioned by gear type and by season. Commercial fishing for Pacific cod occurs near the edge of the continental shelf at depths averaging 170 m in 1996. The Pacific cod fishery generally is open from January to May and September to December and harvests are typically constrained by halibut bycatch limits.

<u>Sablefish</u> was targeted by Japanese freezer longliners since 1959. Catches peaked in 1962 at 28,500 mt and averaged about 13,000 mt from 1963-1972. Vessels from the Soviet Union entered the fishery in 1967. Catches dropped to less than 5,000 mt in 1974, increased to 8,000 mt in 1987, and have since declined. The sablefish TAC is apportioned among gear types, fixed gear and trawl. Commercial fishing for sablefish occurs on the upper continental slope at depths averaging 500 m in 1996. Since 1995, sablefish has been managed under the Individual Fishing Quota (IFQ) system and the season is from March 15 to November 15. Twenty percent of the hook-and-line and pot gear sablefish allocation is a sablefish Community Development Quota (CDQ) reserve.

<u>Greenland turbot</u> has been targeted by trawl and hook-and-line gear. Significant amounts are also retained as bycatch in other fisheries (particularly sablefish). Most fishing occurs in May along the shelf edge and slope at depths averaging 600 m in 1996, as well as along the Aleutian Islands. Catches averaged about 30,000 mt during the 1960s. Catches increased to 60,000 mt in 1974, and remained in the 50,000 mt range through 1983. Catch has remained at or below 10,000 mt since 1986.

<u>Rockfish</u> are harvested by both trawl and hook-and-line gear. Small quantities of Pacific ocean perch were also harvested by hook-and-line gear in 1995. Most of the rockfish catch in hook-and-line fisheries is caught incidentally in the sablefish, Pacific cod and Greenland turbot fisheries.

In 1998, the total hook-and-line groundfish catch was 130,489 mt, representing 8.5 percent of the total groundfish catch (Table 2). In 1998, 77 catcher vessels and 43 catcher/processors operated in the BSAI (Table 3) and targeted sablefish, Pacific cod, Greenland turbot, and rockfish. The BSAI hook-and-line groundfish fleet is characterized predominantly by the larger catcher/processor vessels (freezer-longliners). Catcher-processor vessels accounted for 98.3 percent of the average 3-year harvest from 1996 to 1998 (Table 4). Of the 43 catcher/processor vessels operating in 1998, 79 percent (34) were longer than or equal to 100 ft LOA (Table 3). Seventeen vessels in the BSAI are eligible for the multi-species CDQ program. Based on observer data collected from 1993 to 1997, the average annual estimate of total number of hooks deployed in the BSAI is approximately 128 million.

GOA

Sablefish are an important demersal species of the slope region. Annual catches averaged about 1,500 mt in 1930-50, and exploitation rates remained low until the Japanese hook-and-line fleet expanded into the Gulf. Catches rapidly escalated during the mid 1960s and peaked in 1972. Evidence of declining stock abundance led to significant fishery restrictions from 1977 to 1985 and total catches were reduced substantially. Since 1995, sablefish has been managed under the IFQ system and the fishery occurs from March 15 to November 15.

Pacific cod are a widespread demersal species found along the continental shelf from inshore waters to the upper slope. Catches of Pacific cod increased throughout most of the 1980's in response to a year class(es) which recruited to the fishery around 1980. Annual total catches dropped to about 14,000mt in 1985 as foreign effort began to be phased out, then grew again as the capacity of the domestic fleet increased. The 1991 and 1992 catches reached record levels of approximately 77,000 mt and 80,000 mt, respectively. Presently, the Pacific cod stock is exploited by a multiple-gear fishery, including trawl, hook-and-line, and pot components; the hook-and-line fishery occurs generally from January through March. Trawlers account for the majority of landings with pot gear catches increasing in recent years.

Rockfish have been landed incidental to other groundfish and halibut fisheries in Southeast Alaska since the turn of the century. The directed fishery for demersal shelf rockfish in East Yakutat increased substantially in 1991. The decline in directed harvest since 1992 is a consequence of in-season management to ensure that enough TAC remains for bycatch in the halibut fishery.

In 1998, the total hook-and-line groundfish catch was 27,800 mt, representing 11.3 percent of the total groundfish catch (Table 2). A total of 853 catcher vessels and 18 catcher/processors operated in the GOA (Table 3) and targeted sablefish, Pacific cod, deep-water flatfish, and rockfish. The GOA hook-and-line groundfish fleet is characterized predominantly by the smaller catcher vessels (Table 1). Catcher vessels accounted for 77.7 percent of the average 3-year harvest from 1996 to 1998 (Table 4). Of the 853 catcher vessels operating in 1998, 99 percent (845) were less than 100 ft LOA and 85 percent (728) were less than 60 ft LOA (Table 3). Based on observer data collected from 1993 to 1997, the average annual estimate of total number of hooks deployed is approximately 39 million.

The total number of hook-and-line catcher vessels that caught groundfish off Alaska in 1998 was 873 and the total number of hook-and-line catcher-processor vessels that caught and processed groundfish off Alaska in 1998 was 43 (Table 3). These numbers account for the vessels that operated in both the BSAI and GOA.

Pacific halibut fishery

The Pacific halibut fishery occurs primarily on the continental shelf (50 to 200 m depth) and more rarely on the upper slope (to 400 m depth). During the spring through fall fishing period, Pacific halibut move into shallow water to feed, from the greater winter spawning depths (greater than 400 m depth). In most areas, the continental shelf extends 5 to 100 km offshore, although the shelf extends nearly 800 km in the eastern Bering Sea.

The IFQ program for Pacific halibut was implemented in 1995 to address these over-capitalized fisheries. Under the program, a specified amount of catch is available to eligible persons holding Quota Shares. The IFQ season is from

March 15 to November 15. In 1998, 51 million pounds of halibut were harvested by 1247 vessels (Table 5). Based on IPHC catch and effort data, the total number of hooks deployed in 1996 was estimated to be approximately 11 million (Trumble pers. comm.).

Description of the Gear Used

<u>Groundfish</u>
Hook-and-line gear in Alaska is fished demersally; the gear is designed to sink to the seafloor. In 1996, the average set length was 9 km for the sablefish fishery, 16 km for the Pacific cod fishery, and 7 km for Greenland turbot. Twelve-inch gangions with hooks are attached to the groundline at regular intervals. The average hook spacing in these 3 fisheries is 1.2 m, 1.4 m, and 1.3 m, respectively. Therefore, the average number of hooks per set for the 3 fisheries is 7500, 11,428, and 5385, respectively. The gear is baited by hand or by machine, with smaller vessels generally baiting by hand and larger vessels by machine. Circle hooks are usually used, except for modified J-hooks on some vessels with machine baiters. In the Pacific cod fishery, typically two lines are set and hauled in a day. The vessel travels at a speed of approximately five to seven knots and the gear is usually deployed from the vessel stern during a two-hour set. Radar-reflecting buoys are connected to both ends of the groundline. Most of the hook-and-line vessels in the BSAI targeting Pacific cod are freezer/longliners, many of which use autobaiting systems (Sigler, NMFS pers. comm.).

Hook-and-line vessels targeting sablefish or Greenland turbot set gear in deeper water on the continental slope. Many smaller vessels participate in both the BSAI and GOA fisheries, and fewer are equipped with autobaiting machines.

<u>Halibut</u>
Halibut gear may vary from gear used for groundfish. Traditionally, a unit of gear, or "skate" consists of groundline, gangions, and hooks; the standard “skate” being 0.54 km long with 100 hooks spaced at 5.4 m intervals (hook spacing may vary from 1.5m to 7m). The number of skates deployed in a string varies from 4 to 12, and depends on factors such as the size of the fishing area and the likelihood of snagging on the bottom. Short branch lines (gangions) 1 to 1.5 m long are attached to the groundline and a hook is attached to the end of the gangion. Hooks in the halibut fishery are typically size 16/0 circle hooks. Since the inception of the IFQ fishery, more fishermen are combining halibut fishing with other target species and use a smaller 13/0 hook in the mixed fisheries. Each end of the string is attached to an anchor and buoy line and marked at the surface for detection when gear is retrieved. The skates with baited hooks are set over a chute at the stern of the vessel. Average soak time is 12 hours per skate, but can vary according to fishing area, time of year, and bait used. Baits used in the halibut fishery are either fresh or frozen and historically have included herring, squid, or salmon.

Traditionally, gangions have been tied to the groundline at a set spacing (conventional gear), but more recently gangions may be attached to the groundline with a metal snap fastener (snap-on gear). Snap-on gear is used commonly on small vessels. Conventional gear is set and retrieved in coils. When snap-on gear is set, the hooks are baited and the gangions are attached to the groundline as it unwinds from the drum. Hook intervals can be changed with each set. When the gear is retrieved, the hooks are unsnapped and stored (Trumble, IPHC pers. comm.).

Current Seabird Mitigation Efforts

Regulations

NMFS began monitoring seabird/fishery interactions off Alaska in 1990. NMFS required operators of hook-and-line vessels fishing for groundfish in the BSAI and GOA and federally-permitted hook-and-line vessels fishing for groundfish in Alaska waters adjacent to the BSAI and to the GOA, to employ specified seabird avoidance measures to reduce seabird bycatch and incidental seabird mortality in 1997 (62 FR 23176, April 29, 1997). Measures were necessary to mitigate hook-and-line fishery interactions with the short-tailed albatross and other seabird species. Prior to 1997, measures were not required but anecdotal information suggests that some vessel operators may have used mitigation measures voluntarily. NMFS required seabird avoidance measures to be used by operators of vessels fishing for Pacific halibut in U.S. Convention waters off Alaska the following year (63 FR 11161, March 6, 1998). See the proposed rules as well as the EA/RIR/FRFAs that were prepared for these rulemakings for further discussion of the measures and the development of the regulations (62 FR 10016, March 5, 1997; 62 FR 65635, December 15, 1997; NMFS 1997, 1998).

Regulations at 50 CFR 679.24(e) and 679.42(b)(2) require that all applicable hook-and-line fishing operations must be conducted in the following manner:

1. Use hooks that when baited, sink as soon as they are put in the water.
2. If offal is discharged while gear is being set or hauled, it must be discharged in a manner that distracts seabirds from baited hooks, to the extent practicable. The discharge site on board a vessel must either be aft of the hauling station or on the opposite side of the vessel from the hauling station.
3. Make every reasonable effort to ensure that birds brought aboard alive are released alive and that wherever possible, hooks are removed without jeopardizing the life of the bird.
4. For a vessel longer than or equal to 26 ft (7.9m) length overall (LOA), the operator of the vessel must employ one or more of the following seabird avoidance measures:
    1. Tow a streamer line or lines during deployment of gear to prevent birds from taking hooks;
    2. Tow a buoy, board, stick or other device during deployment of gear at a distance appropriate to prevent birds from taking hooks. Multiple devices may be employed;
    3. Deploy hooks underwater through a lining tube at a depth sufficient to prevent birds from settling on hooks during deployment of gear; or
    4. Deploy gear only during the hours specified in regulation ["hours of darkness" '679.24(e)(3)(iv)], using only the minimum vessel's lights necessary for safety.

Hours that Hook-and-Line Gear Can Be Deployed for Specified Longitudes. Hours are Alaska local time.

	Longitude		
Calendar Month	Shoreward to 150EW	151 to 165EW	166 to 180EW
January	1800-0700	1900-0800	2000-0900
February	1900-0600	2000-0700	2100-0800
March	2000-0500	2100-0600	2200-0700
April	2100-0400	2200-0500	2300-0600
May	2200-0300	2300-0400	2400-0500
June	(hook-and-line gear cannot be deployed during June)		
July	(hook-and-line gear cannot be deployed during July)		
August	2200-0400	2300-0500	2400-0600
September	2000-0500	2100-0600	2200-0700
October	1900-0600	2000-0700	2100-0800
November	1800-0700	1900-0800	2000-0900
December	1700-0700	1800-0800	1900-0900

Pending Changes to the Current Regulations

At its April 1999 meeting, the NP Council recommended that NMFS revise existing seabird avoidance regulations in the following ways:

< Applicable vessels greater than 35 ft (10.7m) length overall (LOA) and using hook-and-line gear must use the prescribed seabird avoidance measures. This revision would effectively exempt IFQ Category D vessels, any vessels less than or equal to 35 ft (10.7 m) LOA, from using seabird avoidance measures.
< Weights must be added to groundlines to cause the groundline to sink out of reach of seabirds.
< Hooks embedded in fish offal must be removed prior to offal discharge.
< Applicable vessels must use either a bird scaring line or night-setting.
< More specific instructions for the deployment of a bird scaring line are provided.
< Buoy bags, bird bags, or float devices would qualify as a bird scaring line but towing a board or

stick would not.

<	Use of a lining tube would have to be accompanied by the use of a bird scaring line.

NMFS is in the process of preparing proposed rulemaking based on the NP Council's recommendation. NMFS anticipates that further regulatory changes may be necessary once results from research testing the effectiveness of these seabird avoidance measures are available in 2001 (see Research section here).

Outreach and Education

Providing information about the causes of seabird bycatch and its mitigation through the use of effective measures is a critical component in efforts to reduce the bycatch. Providing this information to all interested parties---the longline fishing industry, state and federal agencies responsible for fisheries management and seabird conservation and management, environmental groups, and the general public is necessary. Public outreach programs regarding the reduction in seabird bycatch in Alaska hook-and-line fisheries have included: Letters and information packets mailed to fishermen, brochures, laminated albatross identification guides, newspaper articles, news releases and information bulletins, radio interviews, information on internet homepages and a seabird bycatch listserver, and an information booth and seminar at Fish EXPO (industry trade show), among others. A symposium at the February 1999 annual meeting of the Pacific Seabird Group, "*Seabird by-Catch: Trends, Roadblocks, and Solutions*" addressed a wide array of seabird bycatch issues. See the NMFS Alaska Region's seabird link at its website for a list that includes the Alaska Region's seabird-related public outreach activities (http://www.fakr.noaa.gov/protectedresources/seabird_akractivities.pdf).

Current Research Efforts

The FWS Biological Opinion (as required by Section 7 of the Endangered Species Act) on the effects of the BSAI and GOA groundfish fisheries on the short-tailed albatross required NMFS to develop a plan to evaluate the effectiveness of the seabird avoidance measures that were required in 1997. During the public comment period of the proposed rule (62 FR 10016, March 5, 1997), critics of the proposed regulations argued that the more stringent measures required by Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) in southern oceans should be adopted in Alaska's fisheries. Although similar to NMFS regulations in many ways, CCAMLR regulations are more restrictive in that they require vessels to set longlines only at night, and to deploy streamer lines at all times during fishing operations. At that time, no scientific data existed on the effectiveness of any deterrent measures in Alaska's fisheries. The appropriateness of the CCAMLR measures for the conditions of the BSAI and GOA was therefore unknown. NMFS and FWS agreed to endorse more flexible requirements initially for Alaska to allow fishermen, managers and scientists to experiment with devices and determine their effectiveness. Testing the effectiveness of seabird bycatch avoidance measures will allow NMFS to better ascertain if they are effective in the Alaskan fisheries. Once measures have been tested, NMFS will be better able to revise regulations to maximize their effectiveness. This may include specific performance standards for the seabird avoidance measures, if appropriate (NMFS 1997).

The Biological Opinion issued by FWS in 1998 on the effects of the Pacific halibut fishery off Alaska on the short-tailed albatross required NMFS to apply the plan developed to test the effectiveness of seabird avoidance measures in the groundfish fisheries to the Pacific halibut fishery also. The plan must also be implemented and a final report on the evaluation of avoidance measures submitted to USFWS by December 31, 2000.

NMFS completed and submitted to FWS a *Test Plan to Evaluate Effectiveness of Seabird Avoidance Measures Required in Alaska's Hook-and-Line Groundfish and Halibut Fisheries* (Test Plan; see the Test Plan on NMFS' AKR website at http://www.fakr.noaa.gov/protectedresources/testplan.pdf). The Test Plan focuses on three key components to evaluate the effectiveness of seabird avoidance measures: 1) Experimental testing of avoidance measures, 2) collection of information on avoidance measures by observers on commercial vessels, and 3) solicit and gather information from fishermen on the effectiveness of seabird avoidance measures.

The Washington Sea Grant Program (WSGP) began experimental research studies in 1999 to test the effectiveness of selected seabird bycatch deterrent measures in the IFQ halibut and sablefish fishery and in the BSAI Pacific cod freezer-longliner fishery. Paired streamer lines and weighted gear are the two deterrent measures being tested against a control (no deterrent measure) in the IFQ fishery. Line shooters, lining tubes, and weighted gear are the three deterrent measures being tested against a control in the BSAI Pacific cod fishery. This experimental study will continue for its second season in 2000. Results should be available early in 2001. In addition, the observer data seabird protocol that is collected on hook-and-line vessels has been amended to more directly reflect on the effectiveness of the measures that are used.

The IPHC will begin experimental studies in 2000 to compare the effectiveness of towed buoys and towed streamer lines as seabird deterrent measures. The experiments will be conducted in the summer of 2000 onboard commercial vessels chartered by the IPHC for its stock assessment surveys.

Monitoring of Seabird Bycatch

The monitoring of seabird/fishery interactions by NMFS in the groundfish fisheries began in 1990 and was expanded during the 1993, 1997, 1999 and 2000 seasons. The collection of seabird bycatch data was integrated into an existing comprehensive data-gathering observer program designed to collect data for a wide variety of management and research purposes. Data include: total catch and effort, catch composition, prohibited species bycatch, and other biological information.   The major change in 1993 was to have observers provide genus or species identifications of incidentally caught seabirds. During species composition sampling, the observer makes a reliable (to species or species group) identification and records the numbers and weights of birds in the sample. FWS and NMFS use these incidental mortality data by seabird species to calculate bycatch rates of the observed hauls and to extrapolate numbers of seabirds incidentally caught from the observed portions of the fleet to the unobserved portion, resulting in an estimate of total seabird bycatch. Other observer-collected information that NMFS forwards to FWS is: Sightings of sensitive species (six species of special concern whose populations are very small or declining), any bird/vessel interactions, document collisions of birds with the vessel superstructure, and detailed information found on the leg bands of banded seabirds. NMFS coordinated with the FWS to update the seabird section of the NMFS Observer Manual. This included the incorporation of a standardized FWS form for the reporting of sightings of sensitive species. This is the same FWS form that is available to fishermen to report sightings of short-tailed albatrosses.

Observers began providing information about what seabird avoidance measures were being used on hook-and-line vessels in 1997. This information collection was expanded in early 1999 to incorporate more detailed information about the frequency of use of the measures during a fishing trip and specific characteristics of the different avoidance measures, for example, what line weighting regimes are used (number and size of weights, weight spacing on the groundline), construction and deployment characteristics of towed streamer lines and buoy bags, and if offal is discharged for the purpose of distracting seabirds away from baited hooks. Special projects are also being considered that would collect this seabird/gear interaction data on a haul-by-haul basis, rather than by the cruise or trip. The collection of more detailed and specific data will better allow for an analysis of the effectiveness of the avoidance measures at reducing seabird bycatch rates. Beginning in 2000, observers will record the type of seabird avoidance measure that is being used on vessels fishing with hook-and-line gear on a haul-by-haul basis. This will allow for a more detailed analysis of seabird bycatch estimates based on the type of avoidance measure being used, i.e. some indication of the effectiveness of the avoidance measure.

The duties of fisheries observers in the groundfish fisheries off Alaska include (in order of priority): recording incidental take of short-tailed albatrosses and marine mammals, recording fishing effort and catch information, sampling for species composition, documenting compliance problems, collecting biological data on prohibited species, collecting sexed length frequencies and otoliths from the appropriate predominant species, log sightings of “species of interest” seabirds and marine mammals, and completing any assigned special projects (NMFS 1999). On vessels with hook-and-line gear, NMFS observers are instructed to observe the line as it is comes out of the water and to tally every single animal (target fish, fish bycatch, seabird species, etc.) that comes up on that line (for sampled hauls). This tally includes any animals that fall off the hook and are not physically hauled onboard. Observers are instructed to make the best possible identification of these animals, to species or species group, and to estimate their weight (Fitzgerald, pers. comm.).

Recent studies evaluating seabird mortality in the Japanese tuna longline fishery around Australia suggest that more specialist observers may be required to collect more accurate and reliable information on bird catch rates (Gales *et.al.* 1998, Brothers *et.al.* 1998a). Observers on Japanese tuna longline vessels in the Australian Fishing Zone were asked to record details of "passive observations," that is, watch the actual hauling of the longline while not distracted by the additional routine fish sampling tasks. The purpose was for the observer to gain an overall impression of the operation and to assess the number of seabird discards (i.e., birds hooked but not hauled aboard). Seabird bycatch rates were higher for these "passive observations" than for hauls in which the observers were also responsible for fish sampling tasks. The author suggests that more accurate and reliable information on bird catch rates could be attained by: 1) spending more time watching the set to record numbers of birds hooked, 2) spending more time watching for discards to get a more accurate measure of the catch rate, and 3) collecting comprehensive observations on use of mitigation measures (Gales *et.al.* 1998). Based on this description of observer activities in the tuna longline fisheries, NMFS observers in Alaska hook-and-line fisheries are engaged in "passive observations". They are not performing other fish sampling duties while observing the haul and tallying species that are hooked (Fitzgerald, pers. comm.)

The FWS Biological Opinion on the effects of the Pacific halibut fishery off Alaska on the short-tailed albatross requires that all observations and takes of the seabird to be monitored and reported to the FWS. A FWS form to report such encounters was distributed to groundfish and halibut fishermen in 1998. The FWS also requires that NMFS prepare and implement a plan to investigate all options for monitoring the Pacific halibut fishery in waters off Alaska for interactions with the short-tailed albatross, including the use of onboard observers. Preparation of this plan was initiated in 1999. Although the FWS encourages self-reporting of short-tailed albatross encounters, substantial evidence exists that self-reporting by itself is an inadequate method for monitoring protected species encounters in a fishery. The FWS encourages the use of observers on halibut vessels over 60 ft (18.3 m) LOA.

Given that observers are not currently required on Pacific halibut vessels, NMFS and FWS requested the IPHC to monitor sightings of short-tailed albatross and incidental catch of seabirds by Pacific halibut fishermen during 1998. IPHC requested halibut fishermen to maintain records of sightings and incidental catch in their logbooks and the IPHC port samplers interviewed fishermen for seabird information. Despite potential reservations about the reliability of self-reported information for protected species, the pattern of seabird bycatch and short-tailed albatross sightings gained through self-reports is consistent with other available information. In 1998, 457 vessels made both halibut and sablefish landings and 24 percent of these vessels were $\geq$ 60 ft (18.3 m) LOA, therefore groundfish observer coverage requirements would apply (Table 5) and seabird bycatch data would have been collected on these vessels.

Number of Seabirds Taken (FWS Analysis of Seabird Take and Estimation of Seabird Bycatch Rates)

Preliminary estimates of the incidental mortality of seabirds in Alaska groundfish fisheries between 1989 and 1993 indicate that about 85 percent of the total average seabird mortality in all groundfish fisheries during this time occurred in the BSAI. Although trawlers harvest 88 percent of the groundfish in the two regions, about 88 percent of the total seabird mortality occurred in the hook-and-line fisheries (Wohl et.al. 1995).

NMFS has been coordinating with the FWS in its development of statistically valid extrapolation procedures to estimate the total seabird bycatch in the Alaska groundfish fisheries. Preliminary FWS estimates of the annual seabird bycatch in Alaska groundfish fisheries based on 1993 to 1996 data were first reported by FAO (FAO 1999). Preliminary estimates of the annual seabird bycatch for the Alaska groundfish fisheries, based on 1993 to 1997 data, indicate that approximately 14,000 seabirds are taken annually in the combined BSAI and GOA groundfish fisheries (11,600 in the BSAI; 2,400 in the GOA) at the average rates of 0.090 and 0.0568 birds per 1000 hooks in the BSAI and in the GOA, respectively (FWS 1998) (Table 6). Of the estimated 14,000 seabirds that are incidentally caught, the species composition is: 67 percent fulmars, 16 percent gull species, 9 percent albatross species, and 8 percent shearwater species (Table 7). Species composition of the bycatch is listed in Table 8 and the percent composition of take is in Figure 1. NMFS is currently preparing bycatch estimates from 1998 data (and 1999 once that data is available). Information is not currently available as to the potential impacts of the seabird bycatch in the Alaska hook-and-line fisheries on these other seabird species populations.

(Material for this section is adapted from a NMFS document in preparation in 1999, Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Analysis for A Regulatory Amendment to Revise Regulations for Seabird Avoidance Measures in the Hook-and-line Fisheries off Alaska To Reduce Bycatch of the Short-tailed Albatross And Other Seabird Species.)

Table 3. PREDOMINANT HOOK-AND-LINE VESSEL AND GEAR CHARACTERISTICS BY AREA AND VESSEL TYPE AND VESSEL SIZE

AREA AND VESSEL TYPE	BSAI/CATCH. PROCESSOR	GOA/ CATCHER VESSEL	G(
Mean Vessel Length (LOA)	143ft (125-164) & 181 (165-234)	76 ft (60-124)	44
Target Fishery	Pacific cod, sablefish	Halibut , sablefish	Ha
Gear Type	Auto-bait, hand-bait (3 vessels)	Conventional, hand-bait	Sn
Bait Used	Squid	Herring, salmon, squid	He
Average Hooks Set per Day	35,000 to 50,000	approximately 20,000	1,(
Setting Speed	4 to 6 knots	4 to 6 knots	2 t
Fishing Day Cycle	Continuously	16 hours on, 8 hours off	2 s
Distance Behind Stern that Gear Enters Water	5 to 10 ft	6 to 8 ft	1 t
Height Above Water that Gear is Set	3 to 6 ft	3 to 6 ft	1 t

Table 4. GROUNDFISH HOOK-AND-LINE FISHERY STATISTICS

Groundfish hook-and-line target species include: BSAI--Pacific cod, sablefish, Greenland turbot, and rockfish; GOA--sablefish, Pacific cod, rockfish

1998	Total Catch (mt)	
	BSAI	GOA
All groundfish	1.54 million	245 K
H&L portion	130 K	25.5 K
% H&L of Total	8.5%	10.4%

1997	Total Catch (mt)	
	BSAI	GOA
All groundfish	1.74 million	230 K
H&L portion	154 K	26.3 K
% H&L of Total	8.9 %	11.4 %

1996	Total Catch (mt)	
All groundfish	1.75 million	202 K
H&L portion	116 K	27.9 K
% H&L of Total	6.6%	13.8%

Table 5.

Numbers of vessels that caught groundfish off Alaska by area and vessel length class (feet), 1994-98 (excluding catcher-processors).

	Gulf of Alaska				Bering Sea/Aleutian Islands				All Alaska			
	<60	60-99	100-124	>124	<60	60-99	100-124	>124	<60	60-99	100-124	>124
1994	1149	181	14	0	60	26	1	0	1165	185	15	0
1995	901	148	14	2	73	60	3	0	935	151	17	2
1996	821	140	8	5	59	54	4	2	848	141	9	6
1997	822	118	8	3	49	49	3	0	833	119	8	3
1998	728	117	5	3	39	37	1	0	742	123	5	3

Table 6.

Numbers of vessels that caught and processed groundfish off Alaska by area and vessel length class (feet), 1994-98.

	Gulf of Alaska				Bering Sea/Aleutian Islands				All Alaska			
	<60	60-99	100-124	>124	<60	60-99	100-124	>124	<60	60-99	100-124	>124
1994	3	13	12	24	1	15	13	28	3	16	13	28
1995	4	9	8	15	1	7	11	28	3	9	11	28
1996	4	6	8	9	1	7	10	26	4	7	10	26
1997	2	6	8	9	3	7	8	26	4	8	8	26
1998	2	2	6	8	3	6	7	27	3	6	7	27

Note: Includes only vessels that fished part of Federal TACs.

Source: 1998 Economic SAFE Document, Tables 28 and 29. Blend estimates, NMSF permits. National Marine Fisheries Service, 7600 Sand Point Way N.E., BIN C15700, Seattle, WA 98115-0070.

Table 7.

Numbers of smaller vessels that caught groundfish off Alaska by area, vessel length class (feet), 1994-98 (excluding catcher-processors).

	Gulf of Alaska				Bering Sea/Aleutian Islands				All Alaska			
	<26	26-35	36-59	>59	<26	26-35	36-59	>59	<26	26-35	36-59	>59
1994	57	153	939	195	8	13	39	27	63	157	945	200
1995	41	132	728	164	4	21	48	63	44	148	743	170
1996	42	114	665	153	5	12	42	60	47	124	677	156
1997	46	115	661	129	1	14	34	52	46	121	666	130
1998	28	109	591	125	4	13	22	38	29	114	599	131

Table 8.

Numbers of smaller vessels that caught and processed groundfish off Alaska by area and vessel length class (feet), 1994-98.

	Gulf of Alaska				Bering Sea/Aleutian Islands				All Alaska			
	<26	26-35	36-59	>59	<26	26-35	36-59	>59	<26	26-35	36-59	>59
1994	0	0	3	49	0	0	1	56	0	0	3	57
1995	0	0	4	32	0	0	1	46	0	0	4	48
1996	0	0	4	23	0	0	1	43	0	0	4	43
1997	0	0	2	23	0	0	3	41	0	0	4	42
1998	0	0	2	16	0	0	3	40	0	0	3	40

Note: Includes only vessels that fished part of Federal TACs.

Source: 1998 Economic SAFE Document, Tables 28 and 29. Blend estimates, NMSF permits.
National Marine Fisheries Service, 7600 Sand Point Way N.E., BIN
C15700, Seattle, WA 98115-0070.

Table 9. AVERAGE HOOK-AND-LINE GROUNDFISH HARVEST LEVELS BY VESSEL TYPE AND AREA

BSAI	Number of Vessels[1]	1996-1998 Average Harvest (mt)	Percent of Average Harvest
Total Harvest	----	133,435	100.0
By Catcher-processor	44	131,102	98.3
By Catcher vessel	101	2,333	1.7

GOA	Number of Vessels[1]	1996-1998 Average Harvest (mt)	Percent of Average Harvest
Total Harvest	----	28,594	100.0
By Catcher-processor	25	6,389	22.3
By Catcher vessel	920	22,205	77.7

[1]Number of vessels in 1997.

Table 10 PACIFIC HALIBUT FISHERY STATISTICS

1998: 51 million pound commercial take
1997: 51 million pound commercial take
1996: 47 million pound commercial take

Number of vessels making IFQ landings in 1998

Vessel Size Category	Halibut Only	Sablefish Only	Halibut/Sablefish
<26’	223	1	0
26' to <35'	376	1	11
35' to <60'	601	12	335
60' to <125'	47	5	108
125'+	0	6	3
Total	1247	25	457

Table 11 FWS Observed Seabird Bycatch Rates

Estimated catch rates of seabirds of all species in the Alaskan longline groundfish fisheries in the Bering Sea / Aleutian Islands and Gulf of Alaska 1993 to 1997.

Year	Number of hauls observed	Total birds caught	Hooks observed	Birds per 1000 hooks	Standard error (Birds per 1000 hooks)	Birds per mt of fish	% of total estimated catch observed
Bering Sea / Aleutian Islands							
1993	8,315	1,942	30,419,531	0.0638	0.0151	0.0772	29.20%
1994	8,544	2,700	33,835,813	0.0798	0.0157	0.0996	27.16%
1995	8,560	4,851	34,677,010	0.1399	0.0223	0.1557	26.97%
1996	8,247	2,011	33,804,018	0.0595	0.0109	0.0711	26.32%
1997	9,064	4,122	40,034,977	0.1030	0.0201	0.1146	25.15%
5 yr total	42,730	15,626	172,771,349				
Annual Average	8,546	3,125	34,554,270	0.0904	0.0174	0.1058	26.75%
Gulf of Alaska							
1993	2,392	318	5,824,543	0.0546	0.0100	0.0786	10.83%
1994	969	127	2,434,457	0.0522	0.0129	0.0683	6.26%
1995	2,339	374	5,475,360	0.0683	0.0263	0.0829	13.77%
1996	1,793	252	3,653,352	0.0690	0.0201	0.0859	10.27%
1997	1,420	77	2,831,507	0.0272	0.0140	0.0274	10.32%
5 yr total	8,913	1,148	20,219,219				
Annual Average	1,783	230	4,043,844	0.0568	0.0184	0.0710	10.39%

Table 12 FWS Estimated Annual Total Seabird Bycatch, by Species Group

Estimated total incidental catch of seabirds by species or species groups in the Alaskan longline groundfish fisheries in the Bering Sea / Aleutian Islands and Gulf of Alaska 1993 to 1997.

	Short-tailed Albatross	Laysan Albatross	Black-footed Albatross	Northern Fulmar	Gull spp	Shearwater spp	Other spp	TOTAL
Bering Sea / Aleutian Islands								
1993	0	475	11	4,367	920	482	24	6,255
1994	1	350	40	6,606	1,918	968	35	9,883
1995	1	550	52	11,911	3,097	1,765	56	17,376
1996	2	237	23	5,278	1,339	725	43	7,604
1997	1	439	27	12,156	3,095	1,242	42	16,960
5 yr total	5	2,051	153	40,318	10,368	5,182	199	58,078
Annual average	1	410	31	8,064	2,074	1,036	40	11,616
Gulf of Alaska								
1993	0	459	647	1,684	160	114	11	3,065
1994	0	414	803	1,451	143	94	8	2,904
1995	0	266	984	1,279	148	101	9	2,778
1996	0	277	496	1,208	107	66	6	2,153
1997	0	110	123	604	64	37	4	939
5 yr total	0	1,526	3,053	6,227	621	412	38	11,839
Annual average	0	305	611	1,245	124	82	8	2,368
Sum of BSAI & GOA Annual Averages Total	1	715	642	9,309	2,198	1,118	48	13,984

Table 13. Seabirds caught on vessels and reported by NMFS observers in the sampled portion of hook-and-line hauls in the BSAI and GOA groundfish fisheries from 1993 to 1997.

<u>ALBATROSS SPECIES</u> (ALBA)

* Short-tailed Albatross
* Laysan Albatross
* Black-footed Albatross

<u>*NORTHERN FULMAR</u> (NOFU)

<u>GULL SPECIES</u> (GULL)

* Unidentified Gull
* Glaucous-winged Gull
* Glaucous Gull
* Herring Gull

<u>SHEARWATER SPECIES</u> (SHWR)

Unidentified Shearwater
Dark shearwater species
* Sooty Shearwater
* Short-tailed Shearwater
* Storm petrel species
Unidentified tubenose species

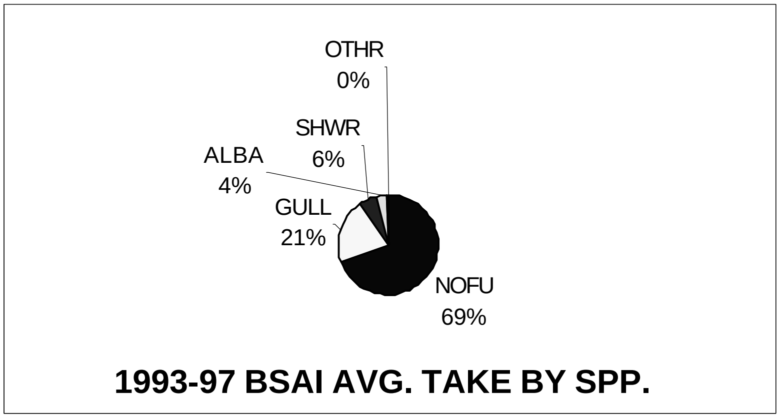
<u>OTHER SPECIES</u> (OTHR)

* Black-legged Kittiwake
Alcid species
* Cormorant species
* Waterfowl species
* Guillemot species
Murre species
* Common Murre
* Thick-billed Murre
* Loon species
* Auklet/Murrelet species

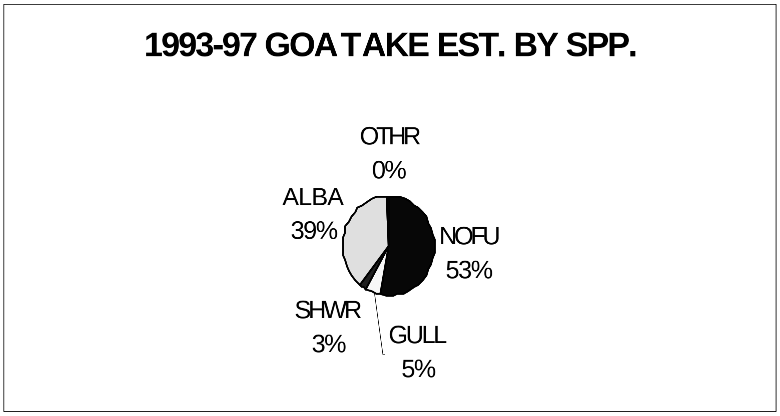
* Unique species or species group

Figure 1. Per cent Seabird Composition by Taxa Groups: northern fulmar, gulls, albatrosses, shearwaters, other. a. Estimated take composition in BSAI groundfish hook-and-line fishery based on 1993-97 observer data. b. Estimated take composition in GOA groundfish hook-and-line fishery based on 1993-1997 observer data.

a.



b.



Western Pacific Regional Fishery Management Council

Introduction

NMFS has five regions located throughout the United States, and the NMFS Southwest Region consists of both management and research entities. Fisheries management, protected resources, and habitat conservation issues are addressed by the Southwest Regional Office located in Long Beach, California, and its field offices in Santa Rosa, Arcata, and Eureka, California; Honolulu, Hawaii; and Pago Pago, American Samoa. Scientific and technical support is provided to the Southwest Regional Office by the Southwest Fisheries Center located in La Jolla, California, and its laboratories in Santa Cruz/Tiburon and Pacific Grove, California, and in Honolulu, Hawaii.

The Pacific Islands Area Office (PIAO), one of the field offices for the Southwest Region, is located in Honolulu, Hawaii. The PIAO assesses, manages, and promotes the conservation of living marine resources in U.S. waters encompassing more than 1.7 million square miles of the Pacific Ocean. The PIAO responsibility for managing protected species extend from the Hawaiian Archipelago to Guam and the Northern Mariana Islands, the islands of the former U.S. Pacific Trust Territory (the Federated States of Micronesia, the Marshall Islands and Palau), and America Samoa. Also included in PIAO's responsibilities are the U.S. Pacific Islands possessions of Johnston Atoll, Wake Island, Kingman Reef Palmyra Atoll, Howland Island, Jarvis Island and Baker Island. The culturally-distinct western Pacific island communities vary widely in terms of language, traditional practices, and local economies, however, dependence on and utilization of the ocean resources. The PIAO plays a major role in strengthening the NOAA/NMFS partnerships with Pacific island communities in the management and conservation of fisheries and protected resources and habitats in the Western Pacific Region. In addition to ensuring that federally managed fisheries do not adversely affect protected species, the PIAO also works to recover endangered and threatened species.

The PIAO and the Southwest Fisheries Science Center (SWFSC) Honolulu Laboratory work cooperatively with the Western Pacific Regional Fishery Management Council (WP Council) on seabird bycatch issues. The WP Council was established by the Magnuson Fishery Conservation and Management Act of 1976 (Public Law 94-265; 16 U.C.S. 1801 et. seq.) to develop FMPs for fisheries operating in the U.S. EEZ around American Samoa, Guam, Hawaii, the Northern Mariana Islands and the remote U.S. Pacific Island possessions.[1] The SWFSC Honolulu Laboratory has been in operation since 1949, and is organized into five research areas: 1) fish biology and ecology; 2) ecosystems and environment; 3) stock assessment; 4) fishery management and performance; and, 5) protected species.

Seabird Bycatch Assessment

The Hawaii-based pelagic longline fisheries exhibit a seabird bycatch problem and in accordance with the FAO IPOA-S, it is the intent of the NMFS Southwest Region, in collaboration with the WP Council and the Hawaii office of the FWS, to implement, the action items described in the U.S. NPOA-S.

Seabirds Affected

Hawaii-based longline vessels targeting broadbill swordfish (*Xiphias gladius*) and tuna (*Thunnus* spp.) inadvertently hook and kill black-footed albatrosses (*Phoebastria nigripes*) and Laysan albatrosses (*P. immutabilis*) that nest in the Northwestern Hawaiian Islands (NWHI).

The NWHI are the primary breeding colonies for the black-footed and Laysan albatross populations and these species range throughout the North Pacific between 20^{o} N. and 58^{o} N. latitude. Black-footed albatrosses are less abundant than Laysan albatrosses at the NWHI, with about 59,622 nesting pairs, versus 558,378 nesting pairs of Laysan albatrosses (Cousins and Cooper in prep.). Ninety-six percent of black-footed albatross nesting sites and more than 99% of Laysan albatross nesting sites are in the NWHI. As the

[1] Howland Island, Baker Island, Jarvis Island, Johnston Atoll, Midway Island, Kingman Reef, Palmyra Atoll, and Wake Island.

number of juvenile (i.e., non-breeding) albatrosses may be five to six times the number of adult (i.e., breeding albatrosses) (Pradel 1996), the total world populations for black-footed and Laysan albatrosses are estimated to be 300,000 and 2.4 million, respectively (Cousins and Cooper in prep.). USFWS census data show that during the last decade the number of breeding pairs of black-footed albatrosses in nesting colonies in the NWHI have increased by about eight percent while the number of breeding pairs of Laysan albatrosses have declined by about ten percent.

The average annual incidental catches of black_footed and Laysan albatrosses in the Hawaii longline fishery represent about 0.6% and 0.06% of the total estimated populations of these species, respectively (Table 18). This source of seabird mortality cannot account for all of the declines in the number of NWHI breeding pairs. Although it is known that foreign longline vessels are operating in the foraging areas of the albatrosses close to the northern boundary of the U.S. EEZ around the NWHI (Cousins and Cooper in prep.), the number of seabirds killed by these vessels is unknown.

Neither albatross species is listed as endangered, but both are protected under the MBTA (16 U.S.C. 703 et. seq.). Under the World Conservation Union (IUCN) criteria for identification of threatened species, the conservation status for the black-footed albatross is currently listed as Vulnerable (Croxall and Gales, 1998). Laysan albatrosses are the most numerous of the North Pacific albatrosses, consequently, the IUCN assigned a "lower risk – least concern" criteria to the species (Croxall and Gales 1998).

The endangered short-tailed albatross (*P. albatrus*) also visit the NWHI. In 1997, a short-tailed albatross was seen flying over a vessel engaged in swordfish longlining research operations northeast of the main Hawaiian Islands (MHI). This was the first, and to date the only, at-sea observation of this species off the Hawaiian Islands. Although no short-tailed albatross has been reported taken in Hawaii's longline fishery, it is possible that longline fishing vessels have encountered this albatross, albeit infrequently given its very low abundance and known range in the North Pacific region. A biological consultation under Section 7 of the ESA was initiated by NMFS in 1999 to determine the effects of the Hawaii-based longline fleet on the short-tailed albatross. This consultation is still ongoing. A biological assessment completed by the NMFS PIAO concluded that, at present, the chance of an interaction between a Hawaii-based longline vessel and a short-tailed albatross is extremely low, but would be reduced further if mitigation measures were employed by longline vessels (NMFS 1999).

Currently, the short-tailed albatross is listed as an endangered species throughout its range under the ESA, except within the states of California, Hawaii, Oregon and Washington (50 CFR 117.11). In Alaska, the short-tailed albatross is listed as endangered under State statutes (Article 4. Sec.16.20.19). Although the FWS published a second proposed rule to list the short-tailed albatross as endangered within the United States (63 FR 58694; November 2, 1998), this has not been finalized as of yet and the short-tailed albatross is not listed as an endangered species in the State of Hawaii. Under the IUCN criteria for identification of threatened species the short-tailed albatross is listed as Vulnerable (Croxall and Gales 1998). The short-tailed albatross is also listed in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES; July 1, 1975) which protects the endangered species by prohibiting its commercial import or export or the trade of its parts across international borders.

Prior to the late 1980s, there were millions of short-tailed albatrosses, and the species was once considered to be the most numerous albatross in the North Pacific. In the late 1980s, however, commercial harvesting of the short-tailed albatross for feathers, oil, and fertilizer at the breeding colonies resulted in the decline of the species to near extinction. The short-tailed albatross is known to breed only in the western North Pacific Ocean, south of the main islands of Japan. Although at one time there may have been more than ten breeding locations (Hasegawa, 1979), today there are only two known active breeding colonies, Minami Tori Shima Island (ATorishima@) (30E 29N N., 140E 19N E.) and Minami-Kojima Island (25E 56N N., 123E 42N E.). Today, the breeding population is estimated at approximately 243 breeding pairs: 213 pairs on Torishima and 30 pairs on Minami-Kojima (Hasegawa, pers. comm.). It is projected that there will be

380 breeding pairs on Torishima by the year 2010[2]. The current world-wide population of Short-tailed Albatrosses is estimated at 1,100 individuals (Hasegawa, pers. comm.).

In the NWHI, the majority of the short-tailed albatross sightings on land are coincident with the breeding season, occurring in the fall and winter months, of October to March. A biological assessment completed by the PIAO estimated that 15 short-tailed albatrosses have visited the NWHI over the past 60 years with only one or two birds present each year (NMFS 1999). Short-tailed albatrosses have also attempted to breed on Midway Atoll. A lone short-tailed albatross female has visited Midway Atoll each breeding season since 1989, and has laid an infertile egg in three breeding seasons between 1994 and 1997. Other sightings of short-tailed albatrosses visiting the Hawaiian Islands (but not displaying breeding behavior) have been reported on Laysan Island (25E 42N N., 171E 44N W.), Green Island, Kure Atoll (28E 25N N., 178E 10N W.) and Tern Island, French Frigate Shoals (23E 45N N., 166E 15N W.).

Three species of boobies also breed in the NWHI and forage in the North Pacific: the masked booby *(Sula dactylatra)*, the brown booby *(Sula leucogaster)* and the red-footed booby *(Sula sula*). Currently, the World Conservation Union classifies boobies as "not globally threatened." To date, there have been no reports of lethal interactions between boobies and the Hawaii-based longline fishery, but boobies are reported to sit on vessel decks and watch the baited hooks as they are being set or hauled back. NMFS observers report boobies hovering over baited hooks and some birds may actually attempt a dive, however, no boobies have been reported hooked.

Generally, boobies tend to fish closer inshore than the albatrosses, with brown boobies fishing closer inshore than the other two species (about 16 to 24 km from shore; Anderson 1954). Masked boobies rarely follow ships, whereas red-footed boobies range far from shore (up to 150 km; Nelson 1978), freely approach vessels and readily perch in rigging. Boobies fish almost entirely by day, with the exception of the red-footed booby which is more nocturnal than the other two booby species, and have evolved to plunge dive (up to 5 m; Nelson 1978) for their prey, using feet as flippers. Some booby species remain underwater for 25 to 40 seconds suggesting a pursuit by swimming (Gibson-Hill 1947). Boobies also specialize in the aerial pursuit of flying fish (*Cypselurus* spp.), catching their prey above or just at the surface of the water.

Albatrosses, on the other hand, are strictly surface feeders making shallow dives for prey items like crustaceans, squid and fish (Harrison *et al.* 1983), as well as baited hooks. Black-footed and Laysan albatrosses have been observed diving after sinking bait using an underwater video camera (C. Boggs, pers. comm.). The deepest dives observed were about 2 body lengths, which is equal to about 1.6 m. Behaviorally, albatrosses also tend to follow vessels more so than boobies and eagerly scavenge offal or galley refuse. The albatrosses have a well-developed olfactory system which assists them in locating food sources from great distances. Albatrosses also have excellent eye sight and use both scent and visual stimuli to locate and retrieve food sources.

Further, albatrosses, even breeding albatrosses with a chick in the nest, tend to roam greater distances in any one foraging trip in comparison to that of the boobies. Although the short-tailed albatross has been described as shy and was thought to rarely follow ships (King 1967), recent observations in Alaskan waters contradict this. This albatross has been reported to follow fishing vessels in Alaskan waters and has been observed attempting to forage ship refuse and baited hooks. Given these differences in foraging behaviors between boobies and albatrosses and the lack of fishery interaction records for boobies, it appears that the albatrosses are the seabirds most at risk of being incidentally caught on Hawaii longline fishing operations.

It is the albatrosses that follow the longline vessels and dive on the baited longline hooks as the vessels deploy their fishing lines that tend to be killed. Incidental catches of seabirds may also occur as the longline is hauled. However, albatrosses are more often killed during longline setting because as they

[2] Based on preliminary population analyses by Dr. Hiroshi Hasegawa, Biology Department, Toho University, Miyama, Funabashi, Chiba, Japan (1997). Short-tailed Albatross: annual survival rate = 96%; % current breeders of the breeding population = 75%; breeding success = 53%; clutch-size = 1; fledgling rate = 0.24; sex ratio = 0.5.

become hooked or entangled, they sink with the fishing gear and are drowned, whereas if birds are hooked during the haul back operation they can be often be released alive. Besides the direct mortality to juvenile or adult albatrosses, fishing-related deaths may also have a negative influence on chick survival if one or both parent birds are killed. Further, when a mate of a breeding pair is killed on longline gear, the remaining mate may lose up to three or more years in search of a new mate (Cousins and Cooper in prep.). If mitigation measures were adopted by the Hawaii-based longline fishery, this would reduce the incidental mortality of albatrosses caught on longlines. In theory, there should be an immediate increase in fecundity due to a reduction in the number of widowed albatrosses searching for new mates. With both parents supplying food to their chicks, there should be an increase in chick and fledgling survival. And, after three to five years of mitigative effort by the Hawaii longline fishermen, there should be a noted increase in juvenile recruitment into the breeding populations.

Description of Fisheries

The current hook-and-line fisheries in Hawaii are dominated by the pelagic longline fisheries. Tunas, broadbill swordfish, and sharks are the dominant components of the Hawaii-based longline catch, but a variety of other pelagic species (Table 14) and some protected species are also caught. The Hawaii-based longline fishery is the largest commercial fishery in Hawaii and accounted for 85% of all commercial pelagic landings (28.6 million pounds) in 1998.

Longline fishing in Hawaii had been conducted for many decades prior to the expansion of the fishery in the late 1980s. Hawaii longline vessels evolved from wooden pole-and-line tuna sampans, employing longlines made from rope and fishing mainly within 2-20 nautical miles of the coast. By the 1930s, the longline fishery was second only to the pole-and-line fishery in landed volume of fish, and accounted for most of the yellowfin (*T. albacares*), bigeye (*T. obesus*) and albacore (*T. alalunga*) landed in Hawaii. The fishery peaked in the mid-1950s with landings exceeding 2000 t and then declined steadily through lack of investment in boats and gear until the late 1980s.

The revitalization of the longline fishery was due to the development of local markets and export markets for fresh tuna on the U.S. mainland and in Japan. Participation in the longline fishery increased from 37 vessels in 1987 to 80 in 1989, and then increased again to 144 vessels in 1991. Following the rapid expansion of the fishery between 1987 and 1991, entry to the longline fishery was halted through a moratorium on permit issuance in 1991, under an amendment to the Council's Pelagic FMP. In 1994, a limited entry program was implemented for the Hawaii longline fishery through another amendment to the FMP. This amendment established a cap of 164 permits for the Hawaii longline fishery, and limited fishing capacity by restricting maximum vessel size to 101 feet.

Landings in the Hawaii longline fishery increased rapidly from 1987 onwards, and by 1991 had reached 9,000 tons, of which 4,400 tons was broadbill swordfish. The new entrants in the longline fishery were mostly steel hulled vessels up to 33 meters in length and their operators were former participants in the U.S. east coast tuna and swordfish fisheries. These newer vessels in the fishery were also characterized by a greater reliance on sophisticated electronic gear for navigation, marking deployed longline gear and finding fish. The revitalized fleet also adopted more modern longline gear, using continuous nylon monofilament main lines stored on spools, with snap-on monofilament branch lines. Over the same period, the range of the longline fishery expanded, with some vessels fishing up to 1,000 nautical miles from Hawaii and over half of the longline sets made at distances greater than 50 nautical miles away from the MHI.

In early 1991, longline fishing was prohibited within 50 nautical miles of NWHI to prevent interactions between the fishery and endangered populations of Hawaiian monk seals (*Monachus schauinslandi*). A further longline exclusion zone of 50-75 nautical miles was established in mid-1991 around the MHI through Amendment 5 of the FMP. The closure around the MHI was in response to alleviate potential gear conflicts between small boat handline fishermen, charter boat operators, recreational fishermen and longline fishermen. Enforcement of the two longline exclusion zones around the MHI and the NWHI is possible with a Vessel Monitoring System (VMS). Hawaii-permitted longline vessels must be equipped with a satellite transponder that provides "real-time" position updates and tracks of vessel movements.

Description of vessels

There are 164 Federal limited entry permits issued for the Hawaii-permitted longline fishery. Hawaii-permitted longline vessels are limited to 101 ft in length, and vessels in the longline fishery are categorized in three size classes: small (<56 ft), medium (56-74 ft), and large (>74 ft) vessels. The majority of vessels operating in the longline fishery are medium- and large-sized vessels. The number of active medium-sized vessels in 1991 was 61, 49 in 1996, and 55 in 1998. The number of active large-sized vessels was 49 in 1991, 35 in 1997, and 42 in 1998. The number of active small vessels decreased from 31 in 1991 to 17 vessels in 1998.

Overall, 114 longline vessels were active in 1998 (Table 1). In 1998, this fishery included 16 vessels that did not fish in 1997, but either began (*n* = 7) or resumed (*n* = 9) fishing in 1998 (Table 2). Among the vessels that resumed activity in this fishery, six of these vessels had fished for swordfish in Hawaii during the early 1990s before migrating to the U.S. mainland in 1994. Since their return to Hawaii in 1998, these six vessels have targeted tunas. Five vessels also left Hawaii in 1998, while two remained in Hawaii, but were inactive in 1998 (Table 2). One noticeable development in the longline fishery in 1998, was the relocation of 18 longline vessels to California (Ito and Machado 1999). An account of the number of vessels for the fleet as a whole and for each gear type between 1991 and 1998, are given in Table 3.

Description of the Gear Used

The Hawaii pelagic longline fleet uses a monofilament longline gear system to target primarily broadbill swordfish and bigeye tuna (Figure 1). Both daytime and nighttime fishing are practiced and vessels generally set a single monofilament longline (i.e., mainline) up to 155.4 km (60 miles) in length. The mainline holds between 600-3,000 branch lines, each about 15-20 meters (49.2-65.6 feet) long holding a single hook. The branch lines are usually weighted with 40-80 grams of lead, but the proximity of the weight to the hook varies by vessel and target species. There are two gear configurations to target either swordfish or tuna. Some longline sets target both swordfish and bigeye tuna and are called “mixed” sets. These sets are typically made with a modified swordfish gear configuration and without the use of a line-shooter.

Swordfish Gear

During swordfish fishing the longline is set at a shallow depth (5-60 m), and the longline gear is configured to sink comparatively slowly. The mainline is set without the use of a line-setting machine. Vessels targeting swordfish use open gap “J” hooks and large imported squid (*Illex* spp.) as bait. These vessels set between 800-1,500 hooks and deploy between 3-5 hooks per float. Swordfish vessels use branch lines with weights (60-80 grams) 5-7 meters from the hook and buoyant luminescent light sticks that attract swordfish and bigeye tuna, or their prey approximately 2-3 meters from the hook. Vessels targeting swordfish set according to the lunar cycle. As a consequence, these vessels set in the late afternoon or in the twilight hours and then haul back the line the next day.

Tuna Gear

Longline vessels targeting bigeye tuna use a line-setting machine (i.e., line-shooter) to deploy sufficient line to achieve a sufficiently deep curve or sag in the longline. In targeting deep swimming bigeye tuna, 18-28 hooks are deployed between floats with lots of sag to reach as deep as 400 meters. Vessels targeting tuna set between 1,200-2,500 tuna ring hooks (i.e., a type of circle hook) and use samna (*Cololabis saira*) as bait. These vessels also use branch lines with 40-80 grams of weight less than one meter from the hook.

Fishing Effort

The number of fishing vessels operating in the Hawaii longline fishery rose from 50 in 1987, to a peak of 141 in 1991, followed by a period of decline and stabilization to between 100 and 110 vessels by the late 1990s (Table 3). Records of fishing activity extend only from 1991, after log books catch records were required of the longline vessels through an FMP amendment. Although the number of vessels active in the fishery has decreased, the overall fishing effort in number of hooks deployed has risen from 12.3 million in 1991, to 17.4 million hooks in 1998 (Figure 15, Tables 3 and 4).

The distribution of fishing effort with respect to targeting has also changed since 1991 (Figure 16 and Table 3). In general, the number of trips targeting principally tuna has risen steadily since 1991. Swordfish targeting trips declined by over 50% after 1994, but showed a slight increase between 1997 and 1998. Mixed target trips declined greatly between 1991 and 1994, with a modest increase between 1994 and 1998. Longline fishing effort is not uniform throughout the year, with a seasonal decline in the number trips and hooks set in the third quarter. The percentage of hooks set in the third quarter represents approximately 18 % of the annual total number set, and the numbers set in the first, second and fourth quarters are about equal and each represent about 28% of the total set each year.

The distribution of fishing effort is not homogenous, with effort distributed between the U.S. EEZ around the Hawaiian Islands, the other U.S. EEZ waters in the Pacific and the high seas. On average, 57% of longline fishing occurs within the U.S. EEZ surrounding the Hawaiian Islands, with a further 40% on the high seas and 3% in the U.S. EEZs of islands such as Palmyra and Kingman Reef, Jarvis and Howland and Baker. The distribution of fishing effort in 1998, was notable for the high volume of fishing within the U.S. EEZs of these mainly uninhabited islands (11.4%), particularly around Palmyra and Kingman Reef. This was in response to the high abundance of bigeye in these waters which occurs periodically in the lower latitudes to the south of Hawaii.

Catch Composition

The average catch composition of the Hawaii longline fishery, from NMFS logbook data between 1991 and 1998, is shown in Figure 4. Logbook catches are reported in numbers of fish, and are subsequently raised to weights using species averages. The two most economically important components of the catch, swordfish and bigeye, make about equal contributions to the catch in numbers, although the largest single component of the catch is sharks, most of which are blue shark (*Prionace glauca)*. Other important components of the Hawaii long line catch include mahi mahi (*Coryphaena hippurus*) and albacore, both forming 11% of the catch, and yellowfin and striped marlin (*Tetrapturus audax*), both forming 5% of the catch. The remainder of the catch comprises other pelagic species such as ono (*Acanthocybium solandri*), blue marlin (*Makaira mazara*), other billfish and moonfish (*Lampris guttatus*).

There has been considerable inter-annual variation of the catch of the various components of the longline catch due to changes in the fishery with respect to targeting. Figure 3 shows the catches of swordfish and three principal tunas in the longline fishery from 1991 to 1998. Swordfish catches reached a peak in 1993, before declining sharply by about 50% in 1994, and have remained at about this level since then. By contrast, tuna landings show strongly increasing trends since 1991, with catches more than doubling for albacore and bigeye tunas.

Monitoring of Seabird Bycatch

The two major sources of information on albatross interactions with Hawaii-based longline vessels are the mandatory logbook and observer data collection programs administered by NMFS. The longline logbook program requires operators of longline vessels to complete and submit to NMFS a data form containing detailed catch and effort data on each set (50 CFR 660.14). Although the information is extensive, it does not compare to the completeness of the data collected by NMFS observers. Furthermore, preliminary comparisons between logbook and observer data indicate under-reporting of protected species interactions by vessel operators in the logbooks (NMFS 1996).

The Observer Program administered by NMFS was implemented in February 1994, to collect data on protected species interactions (marine turtles have highest priority) which include: all sea turtles, especially green, leatherback, and loggerhead turtles; Hawaiian monk seals; selected whale and dolphin species; and seabirds, including the albatross species and the brown booby (*Sula leucogaster*). The Observer Program has achieved 4.7%, 5.5%, 4.9%, 3.5% coverage of all trips in the first four years since it was implemented. The selection of trips to observe is based on a sampling design by DiNardo (1993) to monitor sea turtle interactions.   The PIAO, Southwest Region NMFS, is attempting to increase observer coverage from 5 percent to at least 10 percent.

Although data collection on protected species is the primary purpose of the Observer Program, the observers also collect catch data on the fishery and in total record five different sets of data: 1) incidental sea turtle take events; 2) fishing effort; 3) interactions with other protected species; 4) fishes kept and discarded, by species; and 5) life history information, including biological specimens in some instances. The data from this program cover observed trips from February 25, 1994 (tail end of first quarter 1994), to the end of the fourth quarter of 1998, and are the primary source of statistical information for this assessment.

The NMFS, Southwest Fisheries Science Center, Honolulu Laboratory (NMFS, SWFSC Honolulu Laboratory) used data from NMFS observer reports and the NMFS Western Pacific Daily Longline Fishing Log to estimate the annual incidental catch of seabirds in the Hawaii longline fishery between 1991 and 1998, and the spatial distribution of the catch. Fleet-wide incidental catch estimates were computed using a regression tree technique and bootstrap procedure (Skillman and Kleiber 1998). The regression tree technique reveals structure in observer data sets and can be applied to an array of independent variables (e.g., month, latitude, longitude, target species, gear type, sea surface temperature and distance to seabird nesting colonies). The model is “pruned” by cross validation, meaning that only the statistically significant predictors of seabird catches are kept in the analysis. Catches of black-footed albatrosses were found to be significantly related only to proximity to nesting colonies and longitude, while catches of Laysan albatrosses were significantly related only to proximity to nesting colonies and year (Cousins and Cooper in prep.). The statistical model was then applied to daily logbook records reported by longline vessel captains to generate estimates of fleet-wide seabird catch estimates. The uncertainty in the estimates, expressed as 95% confidence bounds, was assessed with a non-parametric bootstrap technique (Efron 1982; Efron and Tibshirani 1993).

More black-footed albatrosses are reported killed in the Hawaii longline fishery than Laysan albatrosses (Table 18). From the NMFS Observer reports, it is estimated that between 1994 and 1998, an average of 1,392 Laysan albatrosses and 1,831 black-footed albatrosses were killed in the Hawaii longline fishery each year. Black-footed albatrosses tend to be more assertive in their foraging behavior than other seabirds and are known to follow ships, whether fishing vessels or otherwise. In addition, the longline fishermen report seeing more black-footed albatrosses foraging near their vessels than Laysan albatrosses (McNamara, pers. comm.). Albatross behavior, coupled with their numbers, may explain why so many more black-footed albatrosses interact with Hawaii longline fishery than Laysan albatrosses. Recent satellite telemetry studies have shown that in general the Laysan albatrosses tend to fly to Alaska to forage whereas the black-footed albatrosses fly to the west coast continental U.S. (Anderson and Fernandez 1998).

The current world breeding population of the Laysan albatross (558,415 birds) is roughly ten times that of the black-footed albatross (61,866 birds), yet more black-footed albatrosses have been recorded to interact with the Hawaii-based longline fishery, suggesting that the latter species is more seriously affected (Cousins and Cooper in prep.). At present, it is estimated size of the breeding and non-breeding populations of black-footed and Laysan albatrosses are about 300,000 and 2.4 million birds, respectively (Cousins and Cooper in prep.). These average annual incidental catches represent about 0.6% and 0.06% of the estimated worldwide black_footed and Laysan albatross populations, respectively.

Even though no short-tailed albatrosses have been reported near or interacting with a Hawaii-based longline vessel or its gear, a recently completed Biological Assessment (NMFS 1999) assessed the range of maximum annual interactions in the Hawaii longline fishery to be between one to three short-tailed albatrosses, based on the at-sea sighting from aboard the NOAA FRS *Townsend Cromwell* and visitations to the NWHI. The continued sighting of the lone female short-tailed albatross on Sand Island, Midway Atoll, indicates that if the bird interacted with a Hawaii longline vessel and its gear, the interaction was not lethal. Interactions could occur with no injuries to the bird, but hooking and entanglement interactions often lead to a death. Given the historical levels of fishing effort and no interactions of short-tailed albatrosses with the Hawaii longline fishery, the probability of a single interaction was assessed to be extremely low; however, this probability could be reduced if seabird mitigation techniques were employed.

Current Mitigation Efforts

Background Information

Measures taken by the WP Council in the early 1990s to manage the pelagic species fishery also had the additional effect of reducing the incidental catch of seabirds by Hawaii-based longline vessels. These measures include limiting the size of the longline fleet and prohibiting longline fishing in a 50 nautical mile area (protected species zone) around the NWHI. Specific action by the WP Council to reduce the incidental catch of seabirds began in 1996, when the WP Council and the FWS conducted a workshop in September of that year in Honolulu to inform longline fishermen of the problem and various mitigation measures. The book *Catching Fish, Not Birds* by Nigel Brothers (1995) was translated into Vietnamese and Korean and copies were sent to all holders of a NMFS Hawaii longline limited access permit. A second workshop informing fishermen of the problem was held in January 1997. At that time, the FWS also distributed a laminated card showing various species of albatross and describing possible mitigation methods. The card was issued in both English and Vietnamese.

Assessments of the level of voluntarily adoption of mitigation measures by Hawaii longline fishermen indicated that the education program described above was only partially successful. Two dockside visits by WP Council and FWS staff in mid-1997 to examine what mitigation measures, if any, were being employed revealed that, of the 12 longline vessels surveyed, five used weighted hooks, one used bait dyed blue to camouflage it in the water, three towed a trash bag or buoy, one scared birds with a horn, one distracted the birds by strategically discarding offal and two vessels took no measures. A mail survey of 128 Hawaii-based longline vessels was conducted by the Environmental Defense Fund during the same period. Ten of the 18 fishermen that responded to a question regarding mitigation measures employed indicated that they were actively using some type of measure, such as reducing the use of deck lights at night, adding weights to increase the sink rate of the fishing line during setting, strategically discarding offal to distract birds, using a line-setting machine or setting the line under-water.

In October 1997, NMFS observers deployed on Hawaii-based longline vessels began recording which mitigation measures, if any, were being used voluntarily by fishermen. Information from the observer program for 1998 showed that nearly all vessels used some measure, the most common being to avoid setting the line in the vessel wake. About 55% of the vessels thawed the bait before baiting hooks, 29% of the vessels set at night and 11% avoided discarding unused bait while setting the fishing line. Only two percent of the vessels used a towed deterrent or blue-dyed bait.

In October 1998, a seabird population biology workshop was convened in Honolulu to make a preliminary assessment of the impact of fishing by the Hawaii-based longline fleet on the black-footed albatross population in the NWHI. The incidental catch of seabirds by fishing vessels was identified as a source of chronic or long term mortality. It was noted that the impact of the interactions would be more serious if the albatrosses killed were predominantly adult birds because this would result not only in the loss of chicks, but also the loss of many breeding seasons as the surviving mate must find another mate and establish a pair bond. However, banding data analyzed at the workshop suggested that it is predominantly immature juvenile birds that are interacting with longline boats. This finding is consistent with that of Brothers (1991), who observed that about four times as many juvenile as adult albatrosses are caught in the Southern Bluefin tuna (*Thunnus maccoyii*) longline fisheries.

In anticipation that regulatory measures would be required to further reduce the incidental catch of seabirds in the Hawaii longline fishery, the Council in 1998 contracted Garcia and Associates to assess which mitigation methods would be most effective for local vessels under actual commercial fishing conditions. As reported in McNamara *et al*. (1999), the study assessed the effectiveness of various mitigation methods aboard Hawaii-based longline vessels under actual fishing conditions. The mitigation techniques evaluated included several of those identified by Alexander, Robertson and Gales (1997) as being effective in other fisheries, such as night setting, towed deterrents, modified offal discharge practices and thawed bait. In addition, Garcia and Associates evaluated blue-dyed bait, the effectiveness of which appeared promising based on limited use by Hawaii-based longline vessels, but which had not been scientifically assessed.

Because data collected by the NMFS Observer Program show that Hawaii-based longline vessels targeting swordfish had higher incidental catches of seabirds than did vessels targeting tuna (Table 23). Garcia and Associates tested the effectiveness of mitigation measures primarily during swordfish trips. The criteria used by Garcia and Associates to evaluate the effectiveness of mitigation measures included the number of attempts on (chases, landings and dives) and interactions (physical contact) with fishing gear as well as actual hookings and mortalities.

In early 1999, the NMFS, SWFSC Honolulu Laboratory assessed the effectiveness of several seabird mitigation methods during a cruise on a NOAA research vessel in the waters around the NWHI (Boggs in review). This study was designed to supplement the field test of towed deterrents and blue-dyed bait conducted by Garcia and Associates, and to evaluate an additional measure: weighted branch lines. The advantage of using a research vessel to test the effectiveness of mitigation measures was that fishing operations could be controlled to improve the opportunities for observation, comparison and statistical analysis. For example, by setting gear in daylight researchers greatly increased the number of bird interactions with the gear in the presence and absence of each mitigation method. Easily regurgitated net pins were substituted for hooks in the research to avoid injuring seabirds.

During the WP Council meeting in June 1999, the Council requested that NMFS provide analyses of the ecological and economic impacts of the mitigation measures evaluated by Garcia and Associates and the NMFS, SWFSC Honolulu Laboratory. In addition, the Council requested that a range of geographical areas in which the measures would be applied be considered in the impact analyses in order to determine the geographical area that would offer the greatest protection for seabirds with the least negative economic impact on fishermen. The geographical areas considered were: 1) above 25E N.; 2) above 23E N.; 3) within the EEZ around the Hawaiian Islands; 4) within the EEZ around the Hawaiian Islands above 23E N.; and 5) within the EEZ around the Hawaiian Islands above 25E N. latitude.

These mitigation measures and management areas were combined to create four management alternatives. The alternatives range from taking no action (Alternative 1) to prohibiting longline fishing within the EEZ above 23E N. latitude (Alternative 4). Both alternatives 2 and 3 allow longline fishing within the EEZ, but require that vessel operators utilize two or more mitigation measures from a list of six tested measures (Tables 20 and 21); the difference between the two alternatives being that Alternative 2 allows the fishermen to select which measures to employ while Alternative 3 assigns this decision to the Council.

In October 1999, the Council voted to require all Hawaii-permitted longline vessels to choose and employ two or more mitigation measures from a list of six tested measures (Alternative 2) while fishing above 25E N. latitude. In addition, all Hawaii-permitted longline fishermen will be required to annually attend a NMFS workshop on longline protected species interaction mitigation methods and seabird handling technique. All Hawaii longline fishermen will also be required to release seabirds that are caught by longline gear in a manner that maximizes their long-term survival.

Mitigation Measures Tested

<u>*Prohibiting offal discharge during setting and hauling*</u>

Garcia and Associates (McNamara *et al*.1999) report that the retention of offal on-board the vessel during the longline haul led to more attempts (chases, landings and dives) and interactions (physical contact with gear) than if the offal was discarded (Table 24). The retention of offal on-board may increase the hooking of seabirds by longline gear because there is no readily available alternative food source in the water during fishing operations that would distract seabirds from baited hooks. A similar finding was reported in a study of seabird bycatch in longline fisheries targeting Patagonian toothfish (*Dissostichus eleginoides*) in the southern Indian Ocean (Cherel and Weimerskirch 1995). Based on these observations by the Garcia and Associates, as well as the study by Cherel and Weimerskirch (1995), this mitigation measure does not appear to be effective.

<u>*Discharging offal strategically*</u>

The Cherel and Weimerskirch (1995) study reported that when offal was retained the seabird mortality rate was high, but the release of homogenized offal during line setting reduced the incidental catch of seabirds by up to 92%. Garcia and Associates (McNamara *et al.* 1999) also reported that discharging offal strategically is an effective interaction mitigation measure during the longline set (Table 21). However, the researchers note that there is little or no offal generally available during setting operations. Further, the supply of offal may be low when fish catch rates are low or tuna are the target species. Consequently, this mitigation method requires the preparation and storage of offal for use during the longline set, especially when catches are low.

Setting at Night

Of all the interaction mitigation methods tested by Garcia and Associates (McNamara *et al*. 1999), night setting was the simplest measure to employ, and was found to reduce seabird mortalities during the longline set by 73% (Table 20). Overall, mortality of seabirds during night portions of setting operations are far lower than during daylight portions of sets.

Night setting is less effective in reducing interactions with Laysan albatross than with black-footed albatross, possibly because Laysan albatross are more likely to forage at night (Harrison and Seki 1987). The effectiveness of night setting as an interaction mitigation measure may be diminished if chemical light sticks are attached to branch lines as the light sticks may slow the sink rate of baited hooks and illuminate the bait. Aft-facing deck lights aboard the vessel or bright moonlight also can reduce the effectiveness of this measure by illuminating baited hooks at the water's surface.

Dyeing bait blue

Both Garcia and Associates (McNamara *et al*. 1999) and Boggs (in review) reported that blue-dyed bait was the most effective measure tested in mitigating seabird interactions and mortalities during the longline set (Table 20 and 21). Garcia and Associates (McNamara *et al.* 1999) noted that blue-dyed bait is also a highly effective mitigation measure during longline hauling even though soaking many hours in the water may cause the blue color of the bait to fade (Tables 20 and 21).

In the Garcia and Associates study (McNamara *et al*. 1999), both the control bait (undyed) and the treatment bait (blue-dyed) were completely thawed before use. Boggs (in review), however, found that blue-dyed bait is an effective mitigation measure even if the bait is used in a partially frozen condition (Table 22). However, bait must be completely thawed before it can be effectively dyed, and it is expected that commercial fishermen will generally not re-freeze the bait once it has been dyed. Thawed bait sinks faster than frozen bait during the longline set, thereby reducing the time that baited hooks are accessible to seabirds (Brothers *et al*. 1998).

Deploying towed deterrents

Of all the mitigation methods tested by Garcia and Associates (McNamara *et al.* 1999), the tori line and towed buoy system were found to be the most effective measures to reduce attempts and interactions during hauling of the longline (Table 20), but towed deterrents are less effective mitigation measures during the longline set (Table 21). Boggs (in review) also found that a tori line was less effective than blue-dyed bait or weighted branch lines during the setting operations (Table 22). The researchers noted that some individual seabirds either are not scared away from baited hooks at the water's surface during their initial encounter with tori lines or towed buoys or lose their fear of these devices over time.

Garcia and Associates indicated that towed deterrents are less effective in reducing mortalities of Laysan albatross than mortalities of black-footed albatross, possibly because Laysan albatross have a more aggressive or methodical foraging behavior that causes them to continue to dive on baited hooks (McNamara *et al.* 1999). Garcia and Associates also noted that the effectiveness of towed deterrents may be greatly reduced in rough weather, and towed deterrents may become entangled with fishing gear if not closely monitored. An entanglement leaves baited hooks accessible to seabirds unless another towed deterrent is immediately deployed (McNamara *et al.* 1999).

Weighting branch lines

Boggs (in review) reports that adding 60 g of weight to the branch lines reduced interactions by 92% (Table 22). Boggs also noted that the attachment of chemical light sticks to the weighted branch lines did not significantly reduce the sink rate of the baited hooks. The sink rate of weighted branch lines was not measured by Boggs (in review). However, Brothers *et al.* (1995) report that the sink rate of frozen bait weighing 150 to 250 grams is 20 cm/sec when a 10 gram weight is attached and 40 cm/sec when a 50 gram weight is used. These sink rates were measured in 3 meter deep laboratory tanks and demonstrate that in still seawater, sink rates increase substantially with the addition of weight up to about 50 grams and level off as more weight is added. According to Brothers *et al.* (1995), therefore, a frozen bait weighted with about 50 g of lead should sink to 3 m depth approximately 30 m behind a longline vessel setting at 8 knots.

Albatrosses are surface feeders and do not dive as deeply as smaller seabirds or seabirds that are specialized to plunge dive such as boobies (Bergin 1997; Brothers 1991; Brothers *et al.* 1999; Harrison *et al.* 1983). For example, the wandering albatross (*Diomedia exulans*) dive to a maximum depth of 0.6 m (Prince *et al.* 1994), and the shy albatross (*Thalassarche cauta*) dive to a maximum depth of 3.5 m (Hedd *et al.* 1997). Black-footed and Laysan albatross have been observed diving after sinking bait using an underwater video camera (C. Boggs, pers. comm.). The deepest dives observed were about 2 body lengths, which is equal to about 1.6 m. Because albatrosses are shallow divers, relatively small increases in hook sink rates could substantially reduce the incidental catch of seabirds by Hawaii-based longline vessels.

Using line-setting machines with weighted branch lines

The NMFS, SWFSC Honolulu Laboratory assessed the mitigative effectiveness of a line-setting machine used in combination with weighted branch lines (Table 10). NMFS observer records from 1994 to 1998 show that Hawaii-based longline vessels targeting tuna (0.013 birds hooked/set) have substantially lower seabird interactions than those vessels targeting swordfish (0.758 birds hooked/set). The use of a line-setting machine is often a key indicator of the branch line construction and terminal tackle, including the presence of a lead sinker within a meter of the hook which increases the sink rate of baited hooks. Although the actual sink rate of a baited hook deployed with a line-setting machine has not been measured, use of a line-setting machine is likely to increase the hook sink rate by removing line tension during the set. However, the use of a line-setting machine alone, without weighted branch lines, does not appear to increase the hook sink sufficiently to significantly reduce the incidental catch of seabirds (B. McNamara and J. Cook, pers. comm.).

Summary of effectiveness of mitigation measures

Overall estimates of the effectiveness of mitigation measures in reducing the incidental catch of seabirds in the Hawaii longline fishery (Table 24) were computed by averaging the impacts on seabird hooking found by Garcia and Associates (McNamara *et al.* 1999) (Tables 20 and 21), Boggs (in review) (Table 22), and by NMFS observers (Table 23).

Studies of the effectiveness of an array of mitigation measures suggest that all of the measures presented in Table 24 have the potential to significantly reduce the incidental catch of albatrosses in the Hawaii longline fishery. On the other hand, no mitigation measure is totally effective on its own. Furthermore, combining use of mitigation measures is necessary if any single measure significantly loses it effectiveness under certain circumstances (e.g., night setting during a full moon or use of tori line during rough seas) or gradually loses its effectiveness (e.g., if seabirds become habituated to a particular towed deterrent, or blue-dyed bait). Combining use of two or more measures is highly likely to improve overall mitigation effectiveness, although it is uncertain by how much. Due to time constraints, each of these measures were only tested against a control, no combinations have yet been tested.

Possible future seabird mitigation methods and research

One method that appears to offer a great deal of promise for the future are devices that ensure that birds are denied access to baited hooks by setting the line underwater. The simplest of these methods is a metal capsule which can be thrown into the water and retrieved. The baited hook from a branch line is placed in the capsule and the capsule thrown into the sea as the branch line is set. The rapid sink rate of the heavy metal capsule means that by the time the baited hook is released from therein, it is too far below the surface for birds to dive on and retrieve the bait. Trials with bait capsules have shown themselves to be effective on pelagic longline vessels in New Zealand (J. Molloy, Department of Conservation, pers. comm.)

A more expensive but effective method may be to have the branch line set through funnel attached to the boat, with the funnel end well below the water surface. This method removes the visual cue of a hand-thrown baited hook to seabirds and immediately places baited hooks outside the diving range of vulnerable albatross species (between 1.6 m and 3 m; C. Boggs, pers. comm.; Hedd *et al.* 1997; Prince *et al.* 1994). Experimental observations in New Zealand on pelagic longline vessels have shown that at 100 m behind the vessel, hooks set with an underwater setting chute will be about 3 m deeper in the water column than hooks set by hand (J. Molloy pers. comm.).

Another approach to reducing the incidental catch of seabirds in longline fisheries is to increase the sink rate of the baited hooks. A light stick manufacturer (Lindgren-Pitman, Inc.) has just completed the tooling for a battery-driven light stick. This new light stick is negatively buoyant so it should increase the sink rate of the baited hook, thereby reducing the amount of time the baited hooks stay at the surface and available to the birds.

Currently, hook sink rates are for different gear types in the Hawaii pelagic longline fishery are unknown. In theory, a "bird safe" hook sink rate could be determined for Hawaii longline vessels. Albatrosses are surface feeders and rarely dive deeper than two meters. Fishing gear configurations and vessel operations could be modified to achieve a hook sink rate that would greatly reduce the amount of time a baited hook remained at the surface and available to seabirds. For instance, in the Southern Hemisphere, New Zealand longline vessels that sink their baited hooks at a minimum of 0.3 m/sec are permitted to fish in the daylight. This is a new approach to solving the seabird bycatch problem in New Zealand and is still under investigation.

Methods which might be considered but for which there is no compelling evidence of their efficacy include artificial baits or lures with reduced palatability, water cannons and acoustic deterrents to scare birds, and possible high-tech solutions such as the use of intense magnetic fields to disorientate seabirds. However, it is important to continually assess new mitigation methods, and modifications to existing methods, both to improve their efficacy and ease of use, and to cope with possible habituation by seabirds to particular methods.

Collecting albatross foraging information at sea is complicated by the highly migratory nature of the birds, yet there is a need to determine the localities and significance of these feeding areas and to learn about the factors that govern the availability of food at these areas. Placing satellite tags on seabirds is one way to gather spatial and temporal information of albatrosses while at sea. Satellite telemetry studies of albatrosses would yield information on the patterns of flight, time spent in specific regions, and the distances traveled on a daily basis. Results from satellite tag studies could offer an explanation on how the albatrosses exploit oceanic resources.

Besides gaining valuable information of albatross foraging behaviors, satellite tags could also serve as a form of mitigation. For instance, satellite telemetry studies would yield more concise information regarding the spatial distribution and movement patterns of the endangered short-tailed albatrosses. If the short-tailed albatrosses visiting the NWHI were tracked on a daily basis, the foraging patterns and migratory routes of these birds in and out of Hawaiian waters would be more defined. A clearer picture of the potential for interactions between a short-tailed albatross and the Hawaii-based longline fishery could be learned if the daily tracks of these birds were compared to the positions of known fishing activities.

Table 14. List of common and scientific names of fishes encountered by the Hawaii pelagic longline fleet.

Common name	Scientific Name
	PELAGIC MANAGEMENT UNIT SPECIES
Billfish	
Swordfish	*Xiphias gladius*
Black marlin	*Makaira indica*
Blue marlin	*M. mazara*
Striped marlin	*Tetrapturus audax*
Shortbill spearfish	*T. angustirostris*
Sailfish	*Istiophorus platypterus*
Tunas	
Bigeye tuna	*Thunnus obesus*
Albacore	*T. alalunga*
Yellowfin tuna	*T. albacares*
Northern bluefin tuna	*T. thunnus orientalis*
Skipjack tuna	*Katsuwonus pelamis*
Kawakawa	*Euthynnus affinis*
Sharks	
Blue shark	*Prionace glauca*
Thresher (big eye)	*Alopias superciliosus*
Mako (short fin)	*Isurus oxyrinchus*
White tip (oceanic)	*Carcharhinus longimanus*
Tiger shark	*Galeocerdo cuvieri*
Miscellaneous sharks	Families Carcharhinidae, Alopiidae, Sphyrnidae, and Laminidae
Miscellaneous Pelagice Management Unit Species	
Mahimahi	*Coryphaena hippurus*
Wahoo (ono)	*Acanthocybium solandri*
Moonfish	*Lampris guttatus*
Pomfret	Family Bramidae
Oilfish	Family Gempylidae
	MISCELLANEOUS PELAGICS
Lancet fish	*Alepisaurus* spp.
Barracuda	*Sphyraena barracuda*
Brown stingray	*Dasyatis violacea*
	PROTECTED SPECIES
Hawaiian monk seal	*Monachus schauinslandi*
Humpback whale	*Megaptera novaengliae*
Dolphins	Family Delphinidae
Green turtle	*Chelonia mydas*
Olive ridley turtle	*Lepidochelys olivacea*
Hawksbill turtle	*Eretmochelys imbricata*
Leatherback turtle	*Dermochelys coricea*
Laysan albatross	*Phoebastria immutabilis*
Black-footed albatross	*P. nigripes*
Brown booby	*Sula leucogaster plotus*

Table 15. Summary of the Hawaii-based longline vessel entry and exit patterns for 1998.

Activity	Number of Vessels
Total Entries	16
New Vessels	7
Reactivated Vessels	9
Total Exits:	7
Inactive Vessels	2
Left Hawaii	5
Total Active[1] Vessels	114

[1]Active vessels indicate longline vessels taking at least one trip during the calendar year.
Source: Ito and Machado 1999.

Table 16. Summary of vessels, trips, and hooks by trip type by the Hawaii-based longline fishery 1991 to 1998.

Year	Number of Active Vessels	Number of Trips	Number of Hooks[1]
Fleet			
1991	141	1670	12.3
1992	123	1265	11.7
1993	122	1192	13.0
1994	125	1106	12.0
1995	110	1125	13.3
1996	103	1100	14.4
1997	105	1125	15.6
1998	114	1140	17.4
Swordfish Trips			
1991	98	291	2.4
1992	66	277	2.8
1993	19	319	4.0
1994	74	310	3.5
1995	44	136	1.2
1996	33	92	0.93
1997	26	78	0.84
1998	32	84	1.0
Tuna Trips			
1991	104	556	5.2
1992	55	458	5.3
1993	61	542	6.5
1994	83	568	7.0
1995	78	682	9.7
1996	76	657	10.4
1997	83	745	12.2
1998	92	760	13.5
Mixed Trips			
1991	94	823	4.7
1992	72	530	3.7
1993	59	331	2.6
1994	51	228	1.5
1995	49	307	2.4
1996	51	351	3.1
1997	44	302	2.5
1998	50	296	2.9

[1] In Millions of Hooks.
[2] Mixed trips refer to those that target a combination of swordfish and tuna species.
Source: Ito and Machado 1999.

Table 17. Number of active vessels, total catch, and total fishing effort by the Hawaii-based longline fishery, 1991 to 1998.

Year	Number of Active Vessels	Number of Trips	Total Catch[1]	Total Effort[2]
Fleet				
1991	141	1670	19.6	12.3
1992	123	1265	21.1	11.7
1993	122	1192	25.3	13.0
1994	125	1106	18.4	12.0
1995	110	1125	29.7	13.3
1996	103	1100	21.5	14.4
1997	105	1125	27.1	15.6
1998	114	1140	28.6	17.4

[1] In Millions of Pounds.
[2] In Millions of Hooks.
Source: Ito and Machado 1999.

Table 18. Estimated annual total incidental catch of albatrosses in the Hawaii-based longline fishery based on catches recorded by NMFS observers on monitored fishing trips. Values in parentheses are 95% confidence bounds.

	Black-footed Albatross			Laysan Albatross		
Year	Observed Catch	Estimated Total Catch		Observed Catch	Estimated Total Catch	
1994	126	1,994	(1,508-2,578)	73	1,828	(933-2,984)
1995	105	1,979	(1,439-2,497)	107	1,457	(767-2,308
1996	59	1,568	(1,158-1,976)	31	1,047	(569-1,610)
1997	107	1,653	(1,243-2,101)	66	1,150	(599-1,875)
1998	46	1,963	(1,479-2,470)	56	1,479	(822-2,336)

Source: NMFS, Southwest Fisheries Science Center, Honolulu Laboratory Honolulu Laboratory.

Table 19. Description of mitigation measures evaluated by Garcia and Associates (McNamara *et al*. 1999), Boggs (in review) and NMFS, Southwest Fisheries Science Center, Honolulu Laboratory.

Mitigation Measure	Description
A. Discharge offal strategically:	While gear is being set or hauled, fish, fish parts or bait must be discharged on the opposite side of the vessel from which the longline is being set or hauled. If a swordfish is landed, the liver must be removed and the head must be severed from the trunk, the bill removed and the head cut in half vertically. The heads and livers must be periodically thrown overboard on the opposite side of the vessel from which the longline is being set or hauled. Because the supply of offal may be low when fish catch rates are low or tuna are the target species, this mitigation method requires the preparation and storage of offal for use during the longline set, especially when catches are low. The intent of this measure is to divert seabirds from baited hooks to other food sources.
B. Night setting:	The longline set must begin at least one hour after sunset and be completed at least one hour before sunrise, using only the minimum vessel's lights necessary for safety. The purpose of setting fishing gear during hours of darkness is to reduce the visibility to seabirds of baited hooks at the water's surface.

C. Blue-dyed and thawed bait:	An adequate quantity of blue dye must be maintained on board, and only bait dyed a color that conforms to Council/NMFS standards may be used (See Appendix I). All bait must be completely thawed before the longline is set. The objective of dyeing bait blue is to reduce the attractiveness to seabirds of baited hooks at the water's surface. In addition, completely thawed bait tends to sink faster than frozen bait during the longline set, thereby reducing the time that baited hooks are accessible to seabirds.
D. Towed deterrent:	A line with suspended streamers (tori line) or a buoy that conforms to Council/NMFS standards must be deployed when the longline is being set and hauled (See Appendix I). These devices scare seabirds from baited hooks at the water's surface as well as provide a physical barrier that reduces the ability of seabirds to approach the hooks.
E. Weighted branch lines:	At least 45 grams of weight must be attached to branch lines within one meter of each baited hook. The purpose of attaching weights to branch lines is to increase the sink rate of baited hooks, thereby reducing the availability of baited hooks to seabirds.
F. Line_setting machine with weighted branch lines:	The longline must be set with a line_setting machine (line shooter) so that the longline is set faster than the vessel's speed. In addition, weights of at least 45 grams must be attached to branch lines within one meter of each baited hook. The purpose of this measure is to remove line tension during the set, thereby increasing the mainline sink rate and reducing the time that baited hooks are at the surface and accessible to seabirds.

Table 20. Garcia and Associates results: effectiveness of various mitigation measures in reducing seabird attempts, interactions and hookings during longline hauling. Values in parentheses are the number of attempts, interactions or hookings per thousand hooks corrected for the number of birds present.

Mitigation Measure	Percent Reduction in Attempts[1]	Percent Reduction in Interactions[2]	Percent Reduction in Hookings[3]
Prohibit offal disharge	-65 (25.5)	-15 (1.3)	26 (0.4)
Blue-dyed bait	67 (5.2)	93 (0.1)	100 (0)
Towed Deterrent - Tori line	92 (1.2)	93 (0.1)	57 (0.2)
Towed Deterrent - Towed buoy	87 (2.0)	85 (0.2)	62 (0.2)
Control	(15.5)	(1.2)	(0.5)

[1]Defined as a seabird chasing, landing near or diving on baited hooks but not coming into physical contact with fishing gear.
[2]Defined as a seabird coming into physical contact with baited hooks but not becoming hooked or killed.
[3]Defined as a seabird hooked but not necessarily killed.

Source: McNamara *et al*. 1999.

Table 21. Garcia and Associates results: effectiveness of various mitigation measures in reducing seabird attempts, interactions and mortalities during longline setting. Values in parentheses are the number of attempts, interactions or mortalities per thousand hooks corrected for the number of birds present.

Mitigation Measure	Percent Reduction in Attempts[1]	Percent Reduction in Interactions[2]	Percent Reduction in Mortalities
Discharging offal strategically	62 (29.4)	53 (15.4)	86 (0.3)
Night setting	NA	NA	73 (0.6)
Blue-dyed bait	49 (39.3)	77 (7.6)	95 (0.1)
Towed Deterrent - Towed buoy	52 (37.1)	51 (16.1)	88 (0.3)
Towed Deterrent - Tori line	39 (47.1)	52 (15.7)	79 (0.5)
Control	(76.7)	(32.8)	(2.23)

[1]Defined as a seabird chasing, landing near or diving on baited hooks but not coming into physical contact with fishing gear.

[2]Defined as a seabird coming into physical contact with baited hooks but not becoming hooked or killed.

Source: McNamara *et al*. 1999.

Table 22. NOAA research results: effectiveness of various mitigation measures in reducing seabird contacts during longline setting in tests aboard a NOAA research vessel.

Mitigation Measure	Percent Reduction in Contacts[1]
Blue-dyed bait (Thawed and partially frozen)	95
Tori line	76
Weighted branch line	92

[1]Defined as a seabird coming into physical contact with baited hooks with a high likelihood of being hooked.

Source: Boggs in review.

Table 23. Incidental catch of albatrosses in the Hawaii longline fishery by set type based on NMFS observer records from 1994-1998.

Targeted Fish During Set	Observed Bird Catch	Number of Observed Sets	Bird Catch/Set
Swordfish	370	488	0.758
Mixed (Swordfish and Tuna)	472	946	0.499
Tuna[1]	16	1,250	0.013

[1]All vessels targeting tuna use a line-setting machine with weighted branchlines.

Source: NMFS, SWFSC Honolulu Laboratory.

Table 24. Summary of estimated effectiveness of various mitigation measures in reducing the incidental catch of black-footed albatrosses (BF) and Laysan albatrosses (LA) in the Hawaii longline fishery.

Mitigation Measure	Species	Percent Reduction in Incidental Catch
Discharge offal strategically [1]	BF	83
	LA	91
Night setting [1]	BF	95
	LA	40
Blue-dyed bait [1,2]	BF	95
	LA	90
Towed deterrent [1]	BF	86
	LA	71
Weighted branch lines [2, 3]	BF	93
	LA	91
Line-setting machine with weighted branch lines [3]	BF	98
	LA	97

Source: McNamara *et al.* (1999)[1] ; Boggs in review[2]; NMFS, SWFSC Honolulu Laboratory[3].

Secretary of Commerce Highly Migratory Species – Atlantic Ocean

Introduction

The Atlantic Tunas, Swordfish, and Sharks FMP (NMFS 1999) includes many of the highly migratory species (HMS) of the western Atlantic Ocean. In part because of their overlapping ranges with multiple Councils, these species are currently under the management control of the Secretary of Commerce.

Seabird Bycatch Assessment

Bycatch issues have always been important within this fishery complex, although most of the attention has been to marine mammals and sea turtles due to the special protections offered to these species through the Marine Mammal Protection Act and the ESA provisions. These special protections aside, the species complex of seabirds in the Atlantic is such that there are very few interactions noted with seabirds in any of the Atlantic HMS fisheries. Within the three-volume "Final Fishery Management Plan for Atlantic Tunas, Swordfish and Sharks" (NMFS 1999), seabird bycatch was summarized by this paragraph:

> NMFS analyzes observer data to collect sea bird bycatch information. In 1996, no sea birds were reported in Atlantic pelagic longline or purse seine observer data. In 1997, 18 were recorded as dead (11 in South Atlantic Bight, six in Northeast Coastal, and one in Mid-Atlantic Bight) and 15 were recorded as released alive (Northeast Coastal) in the pelagic longline database. Sea birds have not been recorded interacting with other Atlantic HMS fishing gears (NMFS 1999c).

Description of Fisheries

The HMS species of the Atlantic, including the Gulf of Mexico, is comprised of swordfish (*Xiphias gladius*), sharks, and various tunas (mainly *Thunnus* sp.), targeted with a variety of different gears over a very broad geographic area (NMFS 1999).

This complex incorporates many different gear types and fishing styles, although the only ones of interest to this Plan are the pelagic longlines targeting tunas and swordfish, and bottom longlines that target sharks, particularly sandbar (*Carcharhinus plumbeus*) and blacktip (*Carcharhinus limbatus*) sharks.

Current Seabird Mitigation Efforts

Seabird species are already protected, and must be released if caught, preferably alive. Given the current and past low level of interactions with seabirds and longlines in the Atlantic, and the management regimes additionally limiting HMS fishing effort, future interactions are expected to be minimal. In the 1999 HMS FMP, no additional regulatory protections were offered in the Atlantic HMS longline fisheries for the mitigation of seabird bycatch.

Other management measures taken towards both longline types in this fishery complex may prevent the additional take of seabirds, however, such as limited entry into the fishery and additional permits for each of the HMS fisheries. There are also regulations that limit the total catch through an annual quota (for swordfish, bluefin tuna, and large coastal sharks), and minimum sizes on individual fish. All of these actions reduce the total fishing pressure and the opportunity for seabird interactions. Finally, there is also ongoing research into circle hooks and other gear that have shown some reduction in hooking mortality in other longline fisheries.

International Fisheries Organizations

International Convention for the Conservation of Atlantic Tunas (ICCAT)

ICCAT has historically not addressed bycatch issues, although the willingness to discuss incidental takes has been increasing in recent years. Although not often mentioned in formal sessions, the issue of seabirds has been included in many recent bilateral and other meetings between other governments. This will continue to be a priority of the U.S. in future ICCAT fora. To date, there are no formal recommendations relating to seabirds to conduct monitoring programs or to employ mitigation methods within the ICCAT Convention Area.

Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR)

CCAMLR was the first international agreement to directly address the issue of seabird bycatch through the implementation of regulations on mitigation gear. These management actions require the following seven actions:

> 1. Fishing operations shall be conducted in such a way that the baited hooks sink as soon as possible after they are put in the water. Only thawed bait shall be used. 2. For vessels using the Spanish method of longline fishing, weights should be released before line tension occurs; weights of at least 6 kg mass should be used, spaced at intervals of no more than 20 m. 3. Longlines shall be set at night only (i.e. during the hours of darkness between the times of nautical twilight). 4. During longline fishing at night, only the minimum ship's lights necessary for safety shall be used. 5. The dumping of offal is prohibited while longlines are being set. The dumping of offal during the haul shall be avoided as far as possible; if discharge of offal during the haul is unavoidable, this discharge shall take place on the opposite side of the vessel to that where longlines are hauled. 6. Every effort should be made to ensure that birds captured alive during longlining are released alive and that wherever possible hooks are removed without jeopardising the life of the bird concerned. 7. A streamer line designed to discourage birds from settling on baits during deployment of longlines shall be towed.

International Pacific Halibut Commission (IPHC)

The Northern Pacific Halibut Act of 1982 authorizes the North Pacific Council to make management recommendations for the U.S. component of this RMFO. However, the IPHC has a program that will monitor the status of seabirds within the Alaskan component of the fishery. In addition, the Alaska Region has implemented specific regulations designed specifically to mitigate the bycatch of the federally endangered short-tailed albatross. These measures include increasing the sink rate of bait, changing offal discard protocol, and releasing caught seabirds alive if possible. In addition to these measures, larger vessels are required to do one or more of the following: set gear at night, tow a streamer line, tow a buoy or other device, or deploy hooks underwater.

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